THE GEOGRAPHICAL JOURNAL

VOLUME XCIX

JANUARY TO JUNE

1942

PUBLISHED UNDER THE AUTHORITY OF THE COUNCIL

EDITED BY THE SECRETARY

THE ROYAL GEOGRAPHICAL SOCIETY

KENSINGTON GORE LONDON S.W.7

EDWARD STANFORD LTD. 12 LONG ACRE W.C.2

ROYAL GEOGRAPHICAL SOCIETY

Patrons

HIS MAJESTY THE KING
HER MAJESTY QUEEN MARY

Honorary President

H.R.H. THE DUKE OF CONNAUGHT, K.G., G.C.B., G.C.S.I.

THE COUNCIL

(*Elected 23 June 1941 for the Session of 1941–42*)

President : The Rt. Hon. Sir George Clerk, G.C.M.G., C.B.

Vice-Presidents

Leonard Brooks
F. M. Sir Philip Chetwode, Bart, G.C.B., O.M., G.C.S.I., K.C.M.G., D.S.O.
Sqdn. Leader E. H. Keeling, M.C., M.P.
Professor Kenneth Mason, M.C.
The Rt. Hon. Lord Moyne, D.S.O.
Lieut.-Col. Sir Francis Younghusband, K.C.S.I., K.C.I.E.

Treasurer—The Rt. Hon. Lord Plender, G.B.E.

Trustees

The Rt. Hon. Lord Biddulph ; The Most Hon. the Marquess of Zetland, C.G.S.I., G.C.I.E.

Honorary Secretaries—W. L. Sclater J. M. Wordie

Foreign Secretary—Lieut.-Col. Sir John Chancellor, G.C.M.G., G.C.V.O., D.S.O.

Members of Council

Lieut.-Col. F. M. Bailey, C.I.E.
Sir George Binney
Dr. H. C. Darby
Martin de Selincourt
Adm. Sir Edward Evans, K.C.B., D.S.O.
Adm. Sir William Goodenough, G.C.B., M.V.O.
Dr. J. V. Harrison
Alexander King
Colonel Sir Gerald P. Lenox-Conyngham, F.R.S.
Dr. E. J. Lindgren
Dr. N. A. Mackintosh
W. N. McClean
Major-General Sir Cecil Pereira, K.C.B., C.M.G.
The Rt. Hon. the Baroness Ravensdale
Sir E. John Russell, F.R.S.
Dr. K. S. Sandford
Dr. Hugh Scott
Dr. Dudley Stamp
J. A. Steers
L. R. Wager
Sir Ernest Wilton, K.C.M.G.

Secretary and Editor of Publications—Arthur R. Hinks, C.B.E. F.R.S.

Librarian—G. R. Crone

Map Curator—F. Allen

Bankers—Martin's Bank Ltd. (Cocks, Biddulph Branch), 16 Whitehall, S.W.1

910.5
TP81.G1
v.99 Ja-Je 1942

CONTENTS

NO. 1 *JANUARY* 1942

THROUGH WESTERN TIBET IN 1939. By CAPTAIN ROBERT HAMOND 1

THE SARGASSO SEA. By G. E. R. DEACON 16

WESTERN FRONTIERS OF LIBYA. By K. S. SANDFORD . . 29

THE NUER: Review by P. AMAURY TALBOT 40

THE MONTHLY RECORD: Routes to Russia through Iran. The Shepherd of Banbury's Weather Rules. Latitude and azimuth by close circumpolar stars. The mystery of the disposal of the remains of John Baxter 44

NO. 2 *FEBRUARY* 1942

H.R.H. ARTHUR DUKE OF CONNAUGHT, K.G. By SIR GEORGE CLERK 49

THE TALI DISTRICT OF WESTERN YUNNAN. By C. P. FITZGERALD 50

DISCUSSION ON THE GEOGRAPHICAL ASPECTS OF REGIONAL PLANNING. PROFESSOR E. G. R. TAYLOR, LORD FORRESTER, G. D. H. COLE, G. MONTAGU HARRIS, HENRY STRAUSS, M.P., G. W. CADBURY, L. DUDLEY STAMP, E. W. GILBERT . . 61

RECENT DEVELOPMENT IN THE NETHERLANDS-INDIES. By DR. G. H. C. HART 81

REVIEWS: La personnalité géographique de la France. I wore my linen trousers. Iceland past and present. Soviet Asia: progress and problems. The march of the barbarians. Weather analysis and forecasting. Portuguese voyages to America in the fifteenth century. Economic geography: a regional study. The earth and its resources. The ocean in English history 102

THE MONTHLY RECORD: Ground plan of Britain. New explorations by Sir Aurel Stein. Stone Age agriculture in New Guinea. A new geographical periodical in the Netherlands East Indies . . 108

OBITUARY: Dr. John S. Owens, A.M.I.C.E., M.I.MECH.E. . . . 111

NO. 3 *MARCH* 1942

SOME ROUTES IN SOUTHERN IRAN. By J. V. HARRISON . 113

SYRIA AND THE LEBANON. By J. W. CROWFOOT 130

THE EARLY HISTORY OF WATER-SUPPLY. By C. E. N. BROMEHEAD 142

REVIEWS: The English Woodland. Inagua. Astrographics or First steps in navigation by the stars. Rome and China . . . 151

THE MONTHLY RECORD: Honorary President of the Society. The Polar Medal. The capital of Portuguese Guinea. Stonar and the Wantsum Channel. Future irrigation of India. More new processes of colour photography. Recent additions to the Library . . 156

THE GEOGRAPHICAL ASPECTS OF MALARIA. By SIR MALCOLM WATSON 161

A SURVEY OF ANCIENT SITES ALONG THE "LOST" SARASVATI RIVER. By SIR AUREL STEIN 173

THE EARLY HISTORY OF WATER-SUPPLY. By C. E. N. BROMEHEAD 183

TO THE SUMMIT OF TASMAN FROM THE WEST COAST. By ALAN C. BROWNE 196

REVIEWS: Place-names of Middlesex, apart from the City of London. North of Singapore. American Guide Series; New York, and Michigan. Introduction to geology 202

THE MONTHLY RECORD: Peru–Ecuador boundaries. New Zealand glacier studies. The world in two strips. Halley's Tidal Chart of the English Channel. Additions to the Library 205

OBITUARY: Colonel Maurice O'Connor Tandy, D.S.O., O.B.E., late R.E. 208

NOS. 5, 6 MAY–JUNE 1942

SIAM BEFORE THE WAR. By L. DUDLEY STAMP 209

THE CAUCASIAN BORDERLAND. By W. E. D. ALLEN . . . 225

THE BURMA ROAD. By SIR HENRY CRAW 238

THE HARAMOSH PASS. By CAPTAIN EADRIC CLIFFORD FOUNTAINE 247

THE NATIONAL AIR PHOTOGRAPHIC LIBRARY OF CANADA. Contributed by the DEPARTMENT OF MINES, OTTAWA 257

DEVELOPMENT OF MINERAL RESOURCES IN CANADA. Contributed by the DEPARTMENT OF MINES, OTTAWA 260

THE LAST MILLION YEARS: Review by PROFESSOR O. T. JONES . 267

TRAVELS IN THE YEMEN SEVENTY YEARS AGO: Review by HUGH SCOTT 272

REVIEWS: The place-names of West Lothian. Tudor Cornwall. Focus on Africa. Cherry Kearton's travels. The Haitian people. Voles, mice and lemmings: Problems in population dynamics. World shipping. Gypsy afloat 276

THE MONTHLY RECORD: Medals and awards 1942. Pollen-analysis and quaternary geology. The geographical pivot of history. Administrative divisions of the Republic of Panama. Anglo-Soviet scientific cooperation. Prospects of White Settlement in Africa south of the Zambezi 282

OBITUARY: Dr. Heinrich Dübi. Lieut.-Commander L. C. Bernacchi, O.B.E., R.N.V.R. 287

The
GEOGRAPHICAL JOURNAL

Vol XCIX No 1 R.G.S. *January 1942*

THROUGH WESTERN TIBET IN 1939

CAPTAIN ROBERT HAMOND, Royal Norfolk Regiment

Meeting of the Society, 1 December 1941

IN August 1938 I was sent to Kailana, a small hill-station lying between Mussoorie and Simla, where we were shrouded in mists and drenched with rain, and I began to wonder what any one could see in the hills. Within a month the monsoon had lifted and it was our good fortune to see that magnificent section of the snows which runs from Nanda Devi and Trisul in the east, through holy Badrinath and the Gangotri peaks, to Bandarpunch in the west. The sight of these lovely mountains made a great impression on me which I can never forget.

I was unable to get leave that year, but their attraction was so great that I began to contemplate an expedition the next year. In this I was joined by a great friend, T. R. Glancy, of the 19th K.G.V's.O. Lancers. As neither of us knew anything of Himalayan snow work, exploring was more in our line than climbing, and we determined to get to the other side of the snow mountains that we saw every day.

During the winter at Delhi plans gradually grew, and we did a great deal of reading and work. Eventually our pass was granted for June and July 1939. Meanwhile Glancy had joined his regiment, and it was a bitter disappointment to us both that he was able to get leave only during July. So on 1 June 1939 I left the sweltering heat of Delhi Fort and drove alone to Ranikhet, filled with worries and apprehensions about the future; but the smell of the pines and the cool air of the hills drove them from my mind.

British Garhwal

At Ranikhet I had the pleasure of meeting Mrs. A. E. Browne, well known to so many climbers. She had very kindly picked my ponies and sent them out to Garur, thus saving a great deal of time and trouble for me. The next day I was able to drive out to Garur and do my first march. At Ranikhet I also met the Swiss climbing party (Roch, Zogg, Steuri, and Huber), who were proposing to attack Dunagiri *via* the Rishiganga.

My journey through Garhwal was without any important incident and my route was that used by the Kamet party in 1931. I decided to go by the higher route to Ramni, *via* Wan and Kanaul (Kanol), as the lower road through Ghat was liable to be dirty owing to the numbers of pilgrims at this time of year. At one place I lost all my transport for a day and a march was wasted, but otherwise everything went according to plan.

At Ramni I met the Swiss party who had come *via* Ghat, and travelled with them for three more days. On the Kuari pass we were struck by a severe snowstorm before we had put up the tents, and this continued till the late evening, making every one very cold and rather miserable. However it cleared the air and the view of the snows from the pass the next day was wonderful and not marred by cloud at any point. After the clouds had risen and hidden the snows we descended to Tapoban, a bad drop of about 6000 feet down to the Dhauli valley. Here I left the Swiss party and did the four marches up to Niti, the scenery becoming wilder and more precipitous with every mile.

At Niti I had two days' delay while transport was being procured, which was particularly annoying as before leaving Delhi I had written to the headman, Bhupal Singh, had told him the date of my arrival, and asked him to have transport ready. I spent the days in drying and reorganizing all my stores, and in climbing the hills round the camp. I saw some butterflies at 15,000 feet, some *bharal*, and some irises with colours varying from the white of the snows to the dark blue of the skies.

Here I obtained an excellent man who stood me in very good stead for the rest of my journey. Kalian Singh had been a high-altitude porter on Kamet, with Oliver on Dunagiri, and with Major Osmaston during the recent surveys of Garhwal. His job was to translate Tibetan for me and obtain all my transport. He stated that the Niti pass was becoming less and less used owing to the rough and stony path and the dangers of landslides. The alternative route lay over the Chor Hoti pass and the Tun Jun La, and as neither pass had its height marked on the Survey of India quarter-inch map and I had no information of the country round them, I decided to go by this route.

Niti to Gartok

The rates of transport at Niti were extremely high, but I was forced to take them owing to lack of time. They were asking 2 rupees for each of ten animals and 1 rupee 8 annas per man for the five they insisted were necessary for driving the yaks. It was an absolute racket, but I had to agree to their terms or stay where I was. I told them before we started that I should lose no opportunity of doing them down if one arose, and, as luck would have it, I was able to carry out this threat at a later date. In Tibet I found that I could get yaks for a rupee a day or sometimes even eight annas, and that it was only necessary to have one man to four yaks.

We left Niti on June 18 and climbed steadily for 4 miles from 11,600 to 13,500 feet, along a very rough and barren valley. I had caught a bad cold and did not really enjoy the next few days. We stopped for the night at a small camping-ground called *Huniakirk*, where there was little grazing or fuel. I did not attach very much importance to the names of these camps as there

View up valley to Wan

View up Niti valley

Chor Hoti pass

Kuari pass

were numerous alternatives in most cases and no buildings of any sort to mark the place.

The next day I felt very ill, but dared not waste any more time, so we pushed on up the valley. There was little to see of any interest except a hen Monal which flew down from the snows above 17,000 feet. The day was sultry and even the local men felt the altitude a great deal. To add to our difficulties the previous night had been fairly warm and only the top crust of snow had frozen. This would bear a man's weight for a few yards and then break, leaving him to flounder through 3 feet of soft snow to a firmer place, where the same thing would happen again. It was exhausting and discouraging, and I felt sorry for the yaks, who could find few places on the snow that would bear them. It took us 5½ hours to do the 4½ miles from the camp to the Chor Hoti pass, and we rose from 13,600 to 18,200 feet. By now the sun had come out and the glare was very bad even through snow goggles. I had to close the aperture of my Leica down to f/18 and give 1/500th of a second before I could take any photographs.

We rested for a short while on the pass and then descended a very steep shale slope to a large snow-field where the snow was hard as it was on the north side of the mountains. After a few miles we came to a bad drop and the animals had to go a long way round while we clambered down the cliff. Rim Kin, which is marked on the map, is a small pass of about 15,000 feet, but was hardly worthy of notice as we came down to it and only had a short rise of 500 feet to cross it. Just north of Rim Kin is Bara Hoti, where there is a large basin, and here we camped for the night, having done twelve of the hardest miles I have ever known. Four miles north of Bara Hoti, on the northern lip of the basin, is the Tun Jun La, 16,650 feet, which is apparently the political boundary. The geographical divide is obviously the Chor Hoti pass as it is here that the country changes rapidly, the precipitous gorges of Garhwal giving place to the rolling golden hills and green turf of Tibet.

On the climb to the Tun Jun La I picked up several fossils which I believe are ammonites, badly broken or scratched by ice action.[1] I also saw a pair of Brahminy ducks on their way to their Tibetan breeding grounds; there were a few marmots about. From the top of the pass we could see the Ladakh range beyond which lay Gartok, our goal. After a few miles we travelled along the *Sakya Nala* and camped at a point where it meets the *Jindu Chu* and *Tun Jun Chu*, 13 miles from Bara Hoti.

The Survey of India quarter-inch map is very inaccurate between the Chor Hoti pass and *Daba* (Dapa), and I had great difficulty in identifying local features. The yak drivers from Niti again gave trouble, much to the distress of Kalian Singh, who felt partly responsible for them. They were the only really bad hill men with whom I have ever had to deal, and I resolved to be rid of them at the earliest opportunity.

We crossed the Jindu Chu, a fast-running stream about 3 feet deep, which seemed to rise somewhere near the Niti pass, and then climbed to a small pass on the north side called *Nershan*. This was not so much a pass as the edge of the flat Tibetan plain which stretches away to Nabra, Daba, and Toling. After this it was easy walking, over a plateau covered with pebbles and a kind of

[1] Jurassic fossils are found all along here.

flat thistle against which *chaplis* were useless and boots had to be worn. The villages of Lungi and Changlus, which are marked on the quarter-inch map, do not appear to exist, and are certainly not in the places shown. I asked all the Niti men about this, but they denied knowledge of any village nearer than Daba. After a short march of about 6 miles we camped in a deep nullah called the Changlus Nala. The next morning was magnificent and as we climbed up on to the plain again we could see the white dome of Kailas far away to the east and the Ladakh range to the north, while behind us the dawn had touched the Zaskar range and made the peaks very beautiful.

During the day we saw several Kiang (Tibetan wild ass) and some Tibetan shepherds who ran to meet us and seemed astonished to see our strange caravan. The distances were very deceptive and features which appeared to be about 10 miles away I later found to be more like 30 miles. The very clear air has no dust or moisture in it. I believe it was Mr. Wakefield who saw the Kuen Lun mountains from the Ladakh range, a distance of more than 400 miles. I myself saw from near Toling mountains north of the Indus valley in the area of Hanle, and they can hardly have been less than 200 or 300 miles away.

Daba lies in the valley of the Daba Chu, which is about 1000 yards across and 1000 feet deep, with very steep golden cliffs worn into fantastic shapes. Unfortunately my photographs of this area were destroyed and I have only one, in colour, of Daba. From Changlus to Daba is 13 miles and it is four marches from Niti by my route. The village is perched precariously up on the cliff sides and there are numerous caves, some inhabited, and others which are used as store houses. There is a Dzongpön of Daba but he was away at Kailas when I arrived. I had heard that harsh treatment and exacting bargains with the Indian traders had diminished trade here and diverted it farther east to Nabra and Taklakot; but the difficulties of the Niti pass may have had something to do with it.

The local lama visited me and brought with him a travelling lama from Lhasa. Kalian Singh and I secretly arranged a bargain with the lama about new yaks, and when this had been safely settled I paid off the Niti men and told them to go. The surprised indignation on their faces as they heard this news did much to console me for their bad conduct during the past few days.

I rested here for a day and on June 24 yaks appeared in the care of two merry Tibetans. They were pretty wild yaks, and we had endless trouble loading and reloading them as they threw off their loads, but by holding each one down at all four corners we managed at last to get the loads secured and set out for *Manglam* (Mangnang). Between Daba and Manglam are two small villages where the lama's crops are grown. In a sandy nullah I found a large outcrop of a green and polished stone which I was not able to identify. There was no sign of the ruined village of Segge Dzong on the *Rankun Nala*, but as it was ruined in the days of the Pundit Surveys it may well have disappeared by now.

Manglam lies on the west side of the Manglam Tsangpo and consists only of a tiny monastery and a few willow trees. There are one or two good turf camping grounds in the middle of the Tsangpo, which is about 500 yards wide and has two fast streams about 2 feet deep in it. There were many red-

Leo Pargial

Dhauli river

Head Lama's house, Toling monastery

Toling bridge

View down the Sutlej

shanks and four bar-headed geese, the latter so tame that they allowed me to photograph them from about 20 paces. Transport was very cheap here, only 8 annas per animal, but very small donkeys and diminutive cows were among them.

I showed some of the Tibetans a few photographs that I had with me. They seemed to realize what they were, but looked at each one through a half-closed hand, as though through a telescope: perhaps because by doing this and shutting out the local countryside they were better able to concentrate on the picture and get an idea of the real size of the objects in it.

The next day (June 25) we set out to reach Toling, a dull march over completely waterless country. There are several streams marked on the map, but there was no sign of them either dry or running. I met a pilgrim to Kailas who had already been to Ling, as Toling is often called, and was then going on to the Manasarowar lakes. There is a small pass called the *Tseri La* (14,600 feet) half-way to Toling, and from here we could see the snow-covered mountains of Spiti, particularly Leo Pargial, quite easily. Then our road lay along the most awful labyrinth of eroded paths which descended the cliffs to Toling, on the south bank of the Sutlej. The cliffs here are fantastic in shape and sometimes resemble the roofs of an old abbey, so symmetrical are they. The old fort of Toling was built in the cliffs above the present monastery but was without water and therefore was unable to stand the siege of the Kashmir troops.

Toling consists of a monastery and the head lama's house. About a hundred monks gathered to watch us pitch our camp. There are about two hundred to three hundred monks here, I believe, and there are several women who till the small fields and draw water. It is the best-known monastery in Western Tibet, though the closely guarded Rudok and Kailas monasteries are perhaps as important. There is a head lama who deals with the teaching and religious side of the life there and also an administrative lama called the Shangjud who was very young and spoke good Urdu; he interpreted for me. The head lama was extremely courteous, and after an exchange of gifts and compliments and a certain amount of talk which was carried out in reverent whispers, he ordered the Shangjud to show me round the monastery and its library, with many old books that I was not allowed to touch.

Round the central hall of the monastery are small locked rooms, I think twelve in number. These are set aside for different gods and spirits, and there were a few that I was not allowed to enter. There was a vast figure of Badrinath, another depicting Kali or some such deity, others showing the Goddess of Flowers and Crops and Children; and in some rooms were cases full of small figures in brass or gold of the respective god. Some of the figures in the hall were about 16–18 feet high, but it was very gloomy and I was unable to get close enough to see if they were made of plaster, stone, or wood. Outside were enormous prayer wheels and gongs, and also those long horns which rest on the ground and are used for all purposes from giving a warning to the sounding of the calls to a service. The roof of the head lama's house had on it a small pent-house of Chinese design which was roofed with what looked very much like Thok Jalung gold.

My route from Toling to Gartok lay over the Bogo La, a pass of 19,220

feet. All the passes over the Ladakh range in this area are about 19,000 feet and very steep and rough on the southern sides. The normal route from Niti to Gartok goes to Daba or perhaps Nabra, then over the Choko La, a low and easy pass to the north-east of Nabra, and then follows the Gartang valley to Gartok. This route takes longer than the Toling route, but, except when the Gartang valley is full of water, is more practicable, as the other passes are quite often impassable in very severe weather. In no place is there much snow, as Tibet is cold but dry, with a snow-level of between 19,000 and 20,000 feet. The Tibetan snow is frozen as hard as ice by the extreme cold of the wind and altitude.

There were not many animals at Toling, but Kalian Singh at last managed to procure enough to carry my stores. There was the usual dice-throwing for choice of loads, although it was really quite unnecessary as the smallest animal always ends by carrying the heaviest load.

Shortly after leaving Toling on June 26 we crossed an old bridge which was suspended over the Sutlej by enormous wrought-iron chains. Then we travelled again in a narrow labyrinth, ever-ascending, until we descended at last to a stream where there was a small ruined village called *Biey*. The quarter-inch map between Toling and Gartok leaves so much to the imagination and is so inaccurate in the features which it does show, that it is here misleading. Two miles north along this stream is another small village where I saw a few people and some small fields of crops. It is called *Biey-tung-pu*. A little farther on is the village of *Dongpo*, which is larger and boasts several inhabitants and two enormous black poplars. It is 10 miles from Toling.

Here again transport was difficult to obtain, and the next day I was only able to march 7 miles before dark to a small camping-ground pronounced *Poor*, lying on the southern approach to the Bogo La at 16,000 feet. There were many birds here and I saw some Lammergeiers, redstarts, rosefinches, and what I believe to have been orange-fronted Serin finches. Marmots were particularly plentiful, and we continually heard their shrill cries as our caravan approached them. A beautiful sand-coloured hunting dog had attached itself to us at Dongpo and remained with us for many weeks. At Poor all the stones were bright green with occasional blue shades in them and a recent storm had freshened their colour. I believe that they were some kind of Serpentine but am awaiting a report from the Geological Survey of India.

From Poor there is a steep climb of about 4 miles to the Bogo La, and it was bitterly cold in the early morning. I had by now become acclimatized to the altitude, so the Bogo La did not worry me nearly so much as the Chor Hoti had done. From the summit we could see clearly all the country across which we had come and the Zaskar range from about the Untadhura pass in the east to Leo Pargial and the Shipki pass in the west. Northwards the Kailas range rose steeply and obscured our view beyond the Gartang valley. I climbed the hill at the side of the pass and found it to be 19,820 feet. The height given on the map for the Bogo La (19,220 feet) agreed with that shown by my aneroid, and this leads me to hope that my heights for the past few days were perhaps more correct than those given on the map, although often disagreeing with the latter by as much as 1000 feet. It took me some time to take my observations and photographs on the pass, and I was rewarded for

my foolishness in leaving off my gloves by a touch of frost-bite in one hand which troubled me for many weeks afterwards and finally left a scar.

The ground slopes gradually down for 5 miles to some fine pasture land, but after that the path lies along the Kinchung Nala. There are no bridges, and, owing to the steep sides of the ravine, progress can only be made by crossing and re-crossing the rapid stream. This is a slow, wetting, and extremely tiring process. There was a good deal of wild rhubarb growing here, and I found it excellent when stewed. That night (June 27) I camped at a small camp called *Bogol*, as it was nearly dark and Gartok was still 8 miles farther on. We had covered 14 miles during the day and had risen from 16,000 to nearly 20,000 feet and descended again to 15,900 feet. The next morning we continued along the *nala* until we came to the Gartang valley, a marshy plain about 5 miles broad at this point and bounded by the Kailas range on the north and the Ladakh range on the south. There are three or four deep streams running across the marsh and the local men state that these are impassable when the snow starts to melt. Gartok lies on the far side of the plain and we pitched our tents on the camping-ground a few hundred yards from the houses.

At Gartok there are two Garpöns (Viceroys from Lhasa) called Urgu Gong and Urgu Hog respectively. They are supposed to rank in that order of seniority, but I believe that in actual fact they have equal powers of government. They rule the whole of Western Tibet, and their main work seems to consist of squeezing as many taxes as possible out of the people. The money collected is certainly not spent in making any bridges or shelters for travellers and traders or even removing the stones from the main routes so that at least a passable road might in time be made. They live at Gartok (Gar Yersa) in the summer and move to Gargunsa in the winter as it is warmer there. There are about thirty permanent inhabitants at Gartok, but in September a great trading fair is held there and the plain is covered with hundreds of the traders' tents. Gartok and the rule of the Garpöns has been described in great detail by C. A. Sherring in his book 'Western Tibet.'

Both Garpöns were away at Kailas when I arrived, but they had recently had letters from the Government of India notifying them of my arrival, and they therefore sent their Chief Steward or Adjutant to Gartok at once to receive me. Soon after we had pitched camp some tea and a very smelly dried sheep's carcase was sent to me from the Garpön's house. I sent back some presents and asked if I could call that evening. After a while the answer came and Kalian Singh and I went to the house bearing some more gifts. He welcomed me in the courtyard, presented me with a silk scarf (a token of esteem in Tibet), and led me into the house, where we talked and consumed large quantities of rice, tea, and dried *kumanis* (hill apricots). The tea is made by stewing the cheapest China tea for hours and then adding salt, flour, and ghi in the required quantities. It resembles and tastes like the water of an oriental harbour, whatever others may say to recommend it. You have no control over the amount that you drink as it is rude to refuse more or to drink too slowly and your cup is refilled the instant that it is empty.

Like all Tibetans that I met, the Garpön was highly intrigued with my old gramophone which proved a passport to social success in Tibet, especially

with talking and singing records. Carriage on yaks and donkeys does not improve the instrument, and mine was held together with rubber bands and string and played only by a miracle by the time I reached Simla. He was astonished to find that I was only twenty-one, especially as Kalian Singh had told him before my arrival that I was a very important prince, that I drew 30,000 rupees each month, and commanded the Red Fort of Delhi (of which even the Tibetan had heard). All this was because I had casually mentioned to Kalian Singh one day that I had started my journey from the Red Fort where I was living at the time, and he had, Kim like, woven fantastic tales about it.

When he came to visit my camp he expressed a desire for hard-boiled eggs and jam, but when this extraordinary dish had been prepared, with the loss of two of my precious eggs, he vaguely declined it and asked for a biscuit with some jam on it. He was delighted with coloured pictures and photographs, but could not see "why a rich man like myself should forsake the comforts of India and come to Tibet and live in such hardship": here he pointed derisively at my small Meade tent. I tried to tell him that I was on a pilgrimage and only following The Way, like Kipling's Lama in *Kim*, but I do not think he believed or even understood.

Gartok to Shipki

On July 1 I left the capital of Western Tibet and set out for Simla. I had decided to go and look for bar-headed geese on a small lake called the *Tsamda* Gon Tso, 16 miles along the route to Leh from Gartok. My search was rewarded, as I found about four hundred on the Tso and some goslings which I caught and photographed in the Kiumba Chu early the next morning. Then, turning south-west, we joined the Amjung–Iming route from Gartok to Shangtse by crossing four passes which I believe have not been crossed before. They were the *Dakdum La*, 16,450 feet, the *Lalungkircha La*, 18,000 feet, the *Pialonglong La*, 17,550 feet, and the *Durcha Lapcha La*, 17,425 feet. The streams shown on the quarter-inch map in this district are not accurate and not all of them exist. We camped at a small place called *Nursum*, about 2 miles east of the Laoche La. The camp was bitterly cold, as it was 17,150 feet, and in the morning we found even the running streams frozen hard.

We climbed slowly to the Laoche La, 18,400 feet, the wind blowing very hard against us and chilling all to the bone. A very steep drop on the other side of the pass put us into the shelter again, but we had to cross several snow-bridges before coming down to a stream. After about 2 miles there is a camping-ground called *Palong Raru* (Phalang ralrol on the map), and farther on again was a larger one called Debling, just east of the Debling La, 16,500 feet.

From here we could see Kamet very plainly as it dominates the Zaskar range, although we must have been fully 70 miles north of it. Just west of the Debling La is a huge mani-wall called *Kusho Mantang*, about 300 yards long, 5 yards broad, and 5 feet high: the largest that I have seen in Tibet. By now we had come to the edge of a vast stony plain which slopes gradually down to Shang Fort, rather similar to the plain that we crossed after leaving the

Jindu Chu, on our way to Daba. There is a small camp here called *Dara*, 9 miles from Nursum.

The following day we marched for 4 miles across the plain to Shang Fort. Ahead of us we could see the rough desert country over which we should have to go, and beyond that Leo Pargial stood up very clearly. Shang Fort, although very dilapidated, was still inhabited, and there were also several caves in the cliffs bordering the nullah. After this the route lay along a wide nullah for $3\frac{1}{2}$ miles until a small cliff village called Chai was reached. Shangtse lies another 3 miles farther to the west and is the summer home of the Chuprang Dzongpön.

Here I went through more or less the same ceremonies as at Gartok. The Dzongpöns were just changing as the old one was going to Lhasa. There was a monastery with several houses round it, and the village reminded me much more of Toling than of Daba or Gartok. The Dzongpön was an amusing character and showed me two Revelation suitcases, a Mauser repeater, an automatic pistol, and a Winchester "under and over," which he said he always carried on journeys for protection from the many bandits that lived in his country. He insisted that I should take a photograph of him and his family.

He then discussed the route with me. He said that the normal route to Nuk (pronounced *Nū*), was not possible owing to the unfordable state of the Op Chu at this season, and insisted on sending us round by the north, which he said took the same number of marches, although they were rather longer. The normal route lay *via* Kyinipuk, Op, Luk, Nuk. I told him that I was hoping to reach Simla in twenty-two days, as I was several days behind my schedule; but he said that it was not possible in that time. In actual fact I reached Simla in nineteen marches.

We started off from Shangtse on July 5 and climbed to *Shangtse Lapcha*, 14,950 feet, and then on to another pass called *Tanglang Lapcha*, 15,300 feet. The country was very sandy and hard to walk on, and there was no vegetation except for some grass similar to Marrams, and a low-lying pea or vetch, the flowers of which the Tibetans ate greedily. A sharp descent brought us to the village of *Jokche* (Joktse), a fairy-like cluster of cliff dwellings culminating in a pinnacle, at 14,150 feet on the Rabgyeling Chu, where we changed animals. Then another climb followed to the *Depchi* Lapcha, 14,950 feet, and after that a level march across a sandy plain to Rabgyeling Gömpa, 14,300 feet, a pleasant camp lying in the *Sargung* Chu and overlooked by the monastery. Here transport had to be changed again and the next morning we climbed to the *Piridung Lapcha*, 14,950 feet, and the *Tunjin Lapcha*, 14,900 feet, before dropping to the village of Jangtang, which consisted of a few caves in a bleak and sandy nullah at 14,000 feet. Here I had to change animals again, and, as there were not enough to start with, I and An Singh went on with some of the baggage, leaving Kalian Singh to bring on the rest later. Jangtang is shown as being on a ridge, but this is not correct, and in any case no village in this area could exist on a hill owing to the shortage of water.

We climbed again to a small pass called *Kheri Lapcha* and across a plain to a small camping-ground called *Kheri*, where there was a very small water supply. We then turned almost due south, crossed the *Kheri La*, and dropped

down into a maze of deep nullahs. There was no water here, nor any sign of birds, animals, or plants. At last we climbed to the *Anari La*, 15,300 feet, and came down to *Sūmar* Gōmpa (Somar G.) at 15,000 feet, which I estimated is about 3 miles south of the position that it is given on the quarter-inch map. There was a stream and a very small monastery here. Kalian Singh arrived with the baggage just before dark.

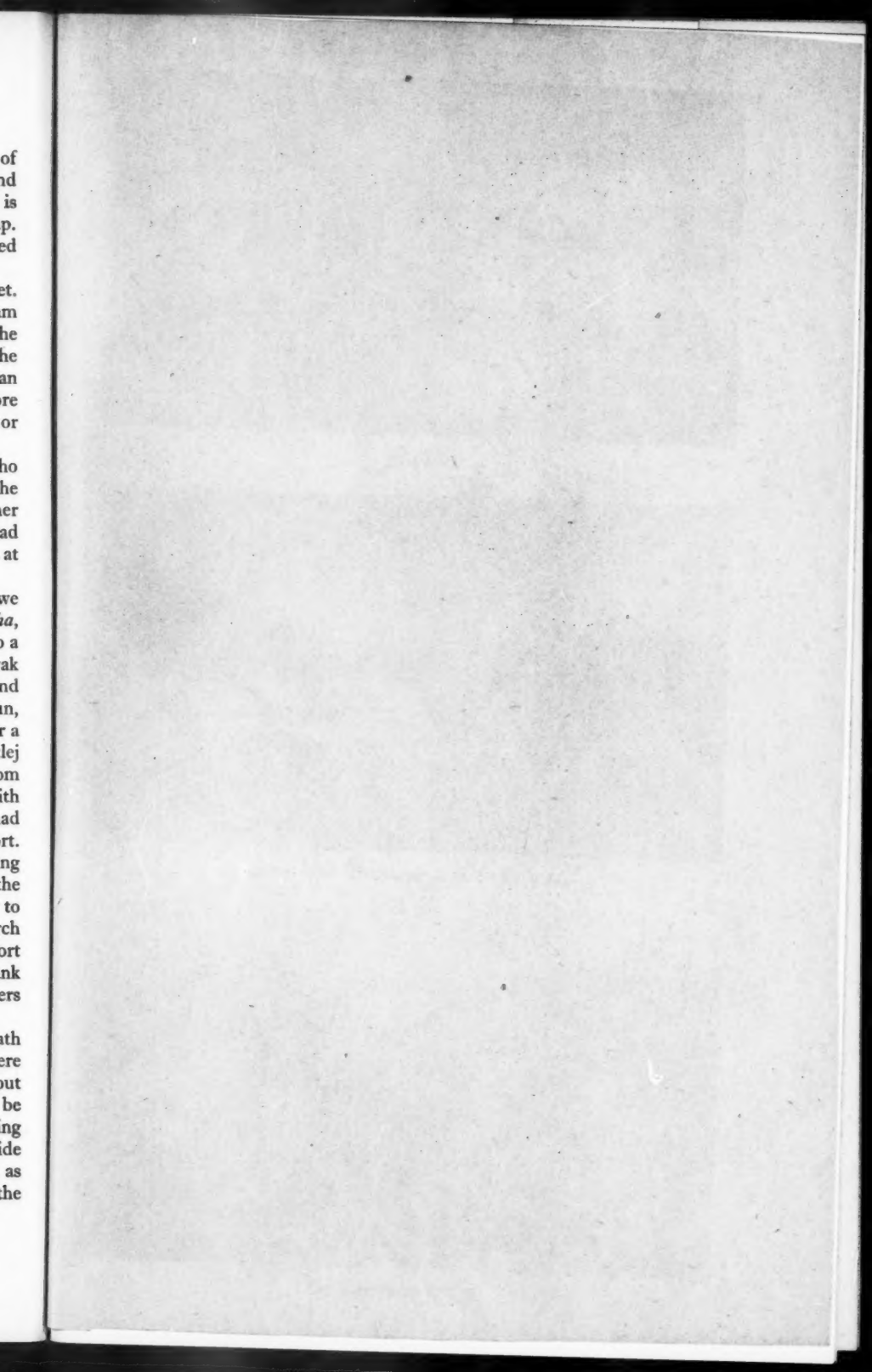
From Sūmar we climbed to *Tanga*, 15,800 feet, and *Dadu*, 16,000 feet. Then followed a very difficult drop of 3000 feet to the Op Chu. The stream was deep and very fast and was crossed by an almost natural bridge as the river here was practically subterranean. While climbing the other side of the gorge I saw two bandits with rifles who, I later learned, had robbed Kalian Singh of his money when I had sent him ahead in the morning to get more transport, but they did not attack us although they fired a shot at someone or something.

Both sides of the Op Chu presented great difficulties to the animals, who took over nine hours to cover the first 5 miles from Sūmar. The pass on the other side of the Chu is called *Dangi Lapcha*, 15,900 feet, and a little farther on is *Rupagong*, 15,850 feet. Although we had only covered 11 miles we had taken thirteen hours to do this, and I decided to stop for the night of July 7 at a small camping-ground in a deep nullah called *Sangtong*, 14,400 feet.

South-west from here the country became slightly less rugged and we crossed three small passes called *Dupgarh La*, 15,400 feet, *Puksum Lapcha*, 15,800 feet, and *Lajungma*, 15,900 feet. Soon after the last pass we came to a very large camping-ground called *Dongpara* (perhaps Dong parao, *i.e.* yak camp), where there were many tents. It is a trade post between India and Tibet, and I talked to many Indians there, some hailing from Dehra Dun, Mussoorie, and Simla. Kalian Singh met me here with new animals. After a small delay we went on to Nuk, which lay on the northern slopes of the Sutlej gorge, about 3 miles distant. I was now back on the normal trade route from Shangtse. I do not know what the normal route is like in comparison with mine, but it could hardly be worse than the arid desert over which I had travelled for the last four days, always on the look out for water and transport.

Nuk is a large village, far larger than Gartok, although from the imposing manner in which the latter is marked on all maps one is led to believe the opposite. There are several camps down by the village, but it is better to stay in the higher camps about 1000 feet above the houses as the next march starts with a long climb to the Rangmik La, 15,400 feet. There is an old fort perched on an incredible eyrie several thousand feet above the north bank over the Sutlej; it appeared to be so inaccessible that I felt that the defenders would have nearly as much trouble in reaching it as the attackers.

After the Rangmik La has been crossed the route lies over fairly open heath land to the foot of the Shiring La. Then it enters a rocky ravine where there was a lot of wild rhubarb growing, and ends with a steep climb of about 1000 feet to the pass, which is 16,800 feet. From here a good view can be obtained of Leo Pargial and the wild, rugged gorge of the Sutlej, roaring through the mountains to Shipki. The descent from the pass on the west side is very bad, as the track is never wider than 2 feet and often as narrow as 9 inches, and runs across an exceedingly steep shale slope. I feared for the



Gartok

Kamet and Himalaya from Debling La

Op Chu from bridge

Rabgyeling Gömpa

Jokche village

Shang Fort

safety of the animals, but they managed the journey extremely well, picking their way gingerly along the very edge of the path.

After a mile or two there is another slight rise and then a difficult drop of nearly 3000 feet down the end of a steep spur. *Miyang* (Ma Dzong) can be seen below. This is a pleasant village and has a few trees and masses of wild roses. The men were all away with sheep and goats, and all the yaks were up on the tops grazing and would have taken a day or two to collect, but the local women volunteered to take my baggage as far as Tyak, the next stage, 6 miles farther on. The next morning, after a great deal of talk, we started off, Kalian Singh obviously enjoying his new charges much more than mere yaks, and keeping up a flow of repartee with them all. They were very independent and rested when and where they wished, but the cheerful atmosphere was very amusing. The road is very rocky and rough and crosses and recrosses a fast stream. Above, the golden cliffs towered up for several thousand feet into the deep-blue sky.

At Tyak I had to get more porters, as I had decided to do a double march and go on to Shipki. It was a pretty village with a few fields and apricot trees and lay at the junction of our stream and the Sutlej. The road from Tyak to Shipki is very dangerous and precipitous, sometimes consisting of a rather insecure scaffolding on the face of the cliff, hundreds of feet above the roaring torrent, and is suitable only for porters or goats as the path is often cut into the cliff and one has to bend double to proceed. After 4 miles there is a small village called Korang, and the Sutlej is crossed by bridge, the first since Toling. A mile farther on is Kiuk and, 3 miles past that, Shipki. We did not arrive here till dark and camped on a very small terraced field as we did not know where the camp lay. The next day we found that it was the other side of the village, and we passed it on our way to the Shipki La. This is the border village and there is a *lumbardar* (headman) here who speaks Urdu and can be very helpful. The Shipki La is 13,420 feet and is the border between Tibet and Bashahr State. As far as I know it is the lowest pass through the Himalaya and is open for a large part of the year. On the pass I rested and looked back to Tibet, just turning golden-brown in the morning sun. Above me towered the Leo Pargial, below me roared the Sutlej, and ahead of us was home and civilization. But, tired though I was after the trials and rush of the past ten days, I felt very sad at leaving Tibet and wondered if I should ever again stand on the Shipki La.

Shipki to Simla

The path down to Namgia is good, as it is maintained by the P.W.D., but there is a terrifying drop of several thousand feet over the edge. I had bruised my foot badly the day before and, as no pony was available, was riding a large black yak. As my bridle would not fit it a small girl was ordered to lead the animal while I sat on its back. A black yak with an old hunting saddle, ridden by a bearded white man and led by a small Tibetan girl along the edge of a precipice must have been a strange sight even in this strange country. As I had no control over either the small girl or the yak, I folded my arms and resigned my fate to them.

At Namgia there is a new P.W.D. bungalow although it is still 194 miles

from Simla. The *chowkidar* (caretaker) was delighted to see me and brought apricots and hot water; I had had no bath since leaving Gartok. The next day I walked 8 miles to Poo, which is a large village and has vegetables and fruit, and there rested for a day. From Gartok to Namgia it is officially thirteen stages, and I had done it in eleven days and by a longer and strange route. During this time I had covered 129 miles, crossed twenty-seven passes of which twenty-two are not named on the map and, as far as I know, have not been crossed before by a European, and put 55 miles of new route on to the map fairly accurately.

For the rest there is little to tell. I did three marches from Poo to Kanum (16 miles), Jangi (11 miles), and Pangi (15 miles). Here I met T. R. Glancy, who had obtained one month's leave and come to meet me. From Pangi we did seven marches to Narkanda, a distance of 116 miles, and finished the last 42 miles to Simla in one day on bicycles, as time was short. All this along the Sutlej valley with a good track and plenty of forest and P.W.D. bungalows. It was a rest after Tibet, but I often thought wistfully of the happy days I had spent in my windswept and cramped tent in that wonderful land.

This last part of my journey lay through the country where Kim and the Babu confounded the Russian travellers and stole their maps and notes before going into hiding with the Woman of Shamlegh. And many other stories such as 'Lispeth of the Kotgarh mission' and 'Namgay Doola' owe their origin to the inspiration of this wild and mountainous land. Kipling understood the Hills when he wrote "The last puff of the day-wind brought from the unseen villages the scent of damp wood-smoke, hot cakes, dripping undergrowth, and rotting pine-cones. That is the true smell of the Himalayas and if once it creeps into the blood of a man that man will at the last, forgetting all else, return to the hills to die."

Those who know and love the hills will remember this feeling, and for myself I also add the musty smell of Toling monastery, the cries of the men urging the yaks up to the pass, and the silence of the eternal snows. The beauty of such a memory outweighs all the discomforts and hardships that had to be undergone in its cause.

In a note at the end of his manuscript, Captain Hamond says: "Any place-name underlined in ink means that either it is not marked on the map or that the spelling on the map is, in my opinion, wrong. In both cases I have endeavoured to obtain the correct phonetical spelling." There are however indications that he has not in all respects followed the R.G.S.II system of spelling. Soon after his manuscript was received he was ordered overseas and there was no opportunity to discuss this matter with him. We have therefore in the text printed his underlined names in italic, and on the map have shown the Survey of India spelling where it differs from his, but his own spelling for places not on the quarter-inch sheets.—ED. *G. J.*

DISCUSSION

Before the paper the PRESIDENT (Sir GEORGE CLERK) said: Captain Robert Hamond is an officer of the Royal Norfolk Regiment, whose battalion was in 1939 stationed at Delhi, and he very wisely resolved to devote two months' leave to a journey into Tibet.

In the autumn of 1904, on his return from the mission to Lhasa, Sir Francis Younghusband detached four British officers to travel westward on the north of the Himalayan ranges, among their objects being to settle the question whether there was or was not any mountain in those ranges approaching or even surpassing Mount Everest in height. A second object was to establish a British trade agent at Gartok. They made the journey from Gartok westward to the Shipki pass and Simla in mid-winter.

Captain Hamond resolved to reach Gartok from Garhwal and to make the journey in the middle of summer by a different route, for few travellers had been that way since 1904 and there was little on record of the summer route. For this journey Captain Hamond received the MacGregor Medal. He has recently been ordered overseas and cannot read his paper himself as he had hoped, so Colonel Mason has very kindly undertaken to read the paper for Captain Hamond.

Lieut.-Colonel Mason then read the paper printed above, and a discussion followed.

The PRESIDENT: We are very fortunate to have with us Colonel Ryder who, I believe, will have something to add on the paper; but before I ask him to address us I should like Professor Mason to say, in Parliamentary language, those things which, I gather, he has to say in regard to certain observations by the writer of the paper.

Lieut.-Colonel MASON: It may be of some interest to recall that the first European explorers of these parts were those intrepid Jesuit missionaries, Father Antonio de Andrade and Brother Manuel Marques, who on 30 March 1624 set out from Agra to search for the Christians reported to be living in Western Tibet.

After considerable hardship they crossed the Mana pass, 17,890 feet, and reached Tsaparang on the Sutlej, some miles downstream of Daba, then the capital of Guge, a prosperous little kingdom in this part of Tibet. On 12 April 1626 a church was founded and for four years the mission flourished; but a revolution broke out in 1630 and the king and the two Jesuits in charge were carried off captive to Leh. The church and mission were sacked and the four hundred converts reduced to slavery.

When Francisco de Azevedo, the Visitor, reached Tsaparang in August 1631, he met considerable hostility from the new governor, and with John de Oliviera, crossed the plateau northwards, passing through Shangtse, Hanle, and Gya on their way to Leh—*i.e.* they crossed both Ryder's and Hamond's routes at right-angles. At Leh they obtained permission to preach Christianity in Western Tibet, but the mission seems to have eventually come to an end about 1640, Manuel Marques being last heard of as a prisoner in Tsaparang in 1641.

When Mackworth Young visited Tsaparang in 1912 he found a number of houses well preserved, but the only trace of church or mission, and that rather doubtful, was a weather-beaten wooden cross on the top of a *chorten*. The population then only consisted of four families.

In these bleak parts settlements rise, flourish, and fall very quickly; and it is not unusual for travellers to find very little trace of a place put on the map by their predecessors only a few years before. Daba, which Hamond passed through, had only a population of twenty when visited by Hugh Rose in 1931. The rest had cleared off owing to the cruelty and extortion of the Dzongpön, an ex-muleteer of Lhasa, who ruled as a tyrant.

I would have liked to ask Hamond whether his excellent companion, Kalian Singh, who met him at Niti, and who had been with Smythe, and Oliver, and

Osmaston on various expeditions, was a descendant of that "Third Pundit" explorer, Kalian Singh, a Bhotia of the same district, who is known in Survey of India Records as GK. I like to think that he is a grandson or great-grandson. For that old GK, with his famous brother Nain Singh, "The Pundit," and with his cousin Mani Singh, G.M. of our records, were the first three "Pundit explorers." It was these three who were sent out by Montgomerie in 1867, disguised as Bashahri traders to clear up the geography of the upper Sutlej. They visited the goldfields of Thok Jalung, mapped the main upper branches of the Indus, and traced for the first time the Sutlej course from Toling to Shipki. Their map had to be made rather surreptitiously and was based on route survey controlled by sextant latitudes at seventy-five points.

You will remember that Hamond met the Swiss climbing party under André Roch on his way up by Ramni. Some people would say that this party had a successful season. On July 5 they climbed Dunagiri, 23,184 feet. On August 8 they climbed Rataban, 20,100 feet, and on August 18 Gauri Parbat, 22,027 feet.

These were all fine climbs; but, like so many newcomers to the Himalaya, the Swiss were not satisfied, and began to take the sort of liberties that the Himalaya is always greedy to avenge. When attempting Chaukamba, 23,420 feet, on September 8, they pitched camp on one of the ice-terraces of its dangerous eastern slopes. As might have been expected after the previous few days of bad weather an avalanche broke away from the shoulder above and the whole surface on which they were camped started to slide. All three tents and their occupants were carried down between 1500 and 2000 feet, and two porters, Gombu Sherpa and Ajitia Dotial, were killed and others injured. The rest of the party escaped by a miracle, and through no skill of their own.

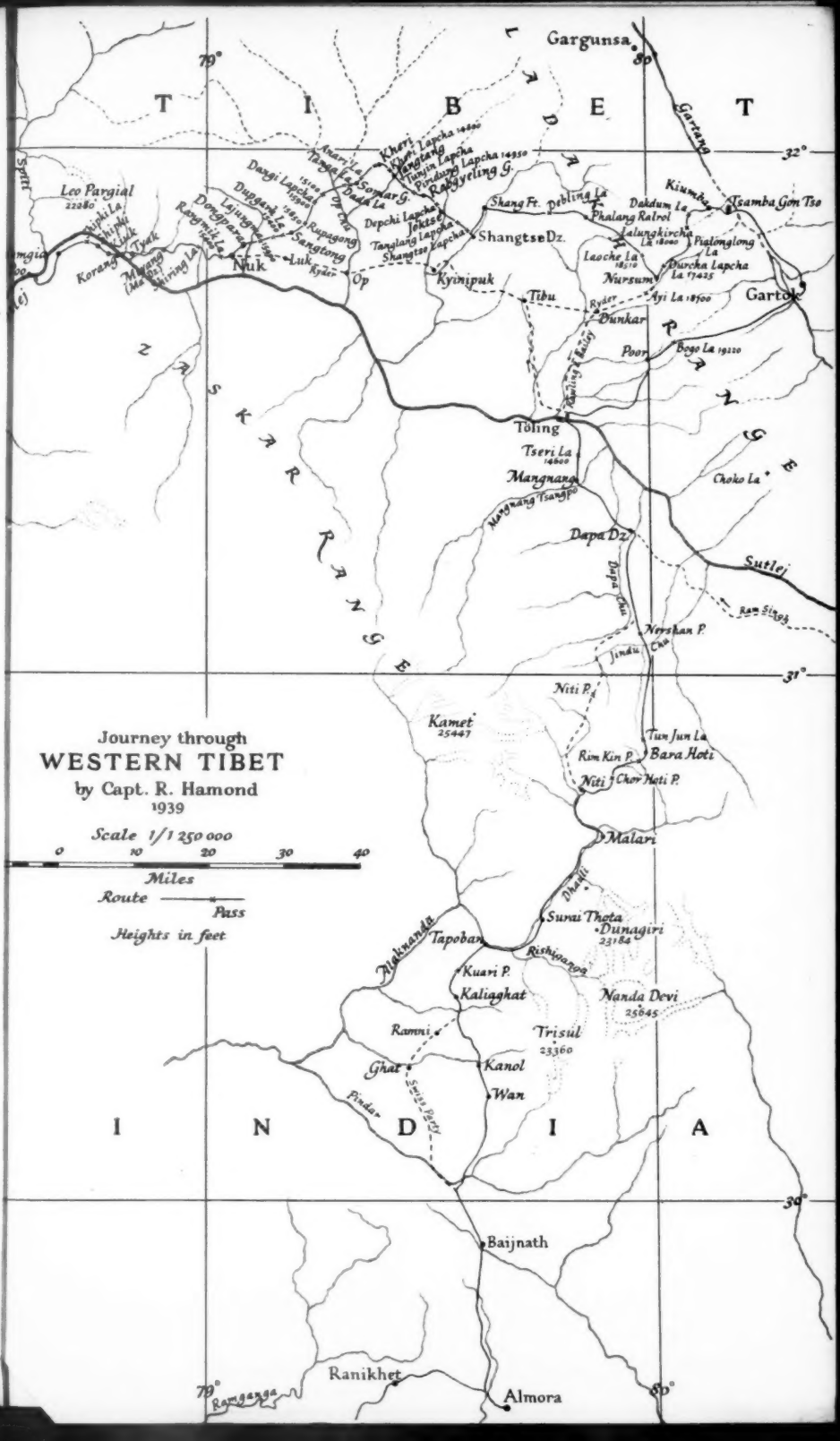
Colonel C. H. D. RYDER: As you will have gathered from some of the photographs, my journey was made thirty-seven years ago, and of the four of us on that journey, only two now survive. But I like to feel that the spirit of exploration is still strong, and I have listened to the description by Captain Hamond with the greatest interest. I suppose I am the only person in the room who has been in the part of the world he has described, and I can say his descriptions are very accurate.

It is curious that in a country of that type there should be a wealth of wild flowers at certain seasons of the year. At certain periods of the year you pass over howling and bare desert, and then, suddenly, in the spring you will find that transformed into a place carpeted with flowers of every description.

Then there are the animals. The marmot is a wonderful companion and an interesting little creature to watch. Marmots are nervous, but they have one most obvious etiquette. A marmot, when frightened, may run to another marmot's hole as hard as he can go, but immediately he gets there he must come up to the top of the hole and look round to see whether the danger is really urgent; if not, he must immediately go on to his own hole. You will see twenty, thirty, or fifty of them all running to holes, and at once they come up, look over the top, and about three-quarters of them run off to their own holes, leaving the rest as they were.

My journey over the area we have had mapped was made at the end of a long and arduous journey to Lhasa under Sir Francis Younghusband. The four of us were all rather tired. We collected what stores we could for our journey, while the rest returned to India and reached there in plenty of time. We had to face the problem of being caught by the weather and having to winter in Tibet. Our supplies were very meagre; the cold very intense. I can now look back with a certain amount of amusement on what was far from amusing at the time.

For instance, our journey was practically due west up to Rampur and, as you


Journey through
WESTERN TIBET
by Capt. R. Hamond
1939
Scale 1/1 250 000
0 10 20 30 40
Miles
Route
Pass
Heights in feet
TIBET
INDIA
ZASKAR RANGE
GREAT HIMALAYA RANGE
Gargunsa
Gartang
Leo Pargial 22280
Nuk
Op
Kyunipuk
Shangtse Dz.
Tibu
Dunkar
Gartok
Kiumba
Tsamba Gon Tso
Dakdum La
Phalang Ralrol
Lalungkircha La 18000
Laoche La 18510
Nursumi
Burcha Lapcha La 17425
Ayi La 18500
Poon
Bego La 19220
Toling
Tseri La 14800
Mangnang
Choko La
Dapa Dz.
Sutlej
Ram Sing
Norshan P.
Jindu Chu
Niti P.
Kamet 25447
Tun Jun La
Rim Kin P.
Bara Hoti
Niti
Chor Hoti P.
Malari
Dhauli
Sunai Thota
Dunagiri 23184
Rishiganga
Tapoban
Kuari P.
Kaliaghat
Nanda Devi 25645
Ramni
Trisul 23360
Ghat
Kanol
Wan
Pindar
Baijnath
Ranikhet
Almora
Ramganga
79°
80°
32°
31°
30°

all know, being geographers, when you are travelling due west and riding a pony your left leg is in the sun on the sunny side of the pony, your right is in the shade of the pony. The cold was so intense that it was necessary after ten minutes on the pony to either get off and walk or sit with your back towards the way the pony was travelling so as to get the right leg warmed up in the sun.

Our expedition actually went up to Gartok to establish a trade agent there. That we did, and then we had only one idea, to get back to civilization as fast as we could, over that ghastly country we have seen in the photographs, country cut up by ravines running in every direction. There was one advantage we gained from the extreme cold. Many of the streams which in summer when the snow has melted are roaring torrents were frozen hard, and we could cross them with ease. To that extent we had an easier time than Captain Hamond had when there in the middle of the summer.

One of the items that interested me most in the paper was the statement that Captain Hamond is only twenty-one. I like to think that the men of the younger generation are also explorers. I did not know until I came here this afternoon that he was in the Royal Norfolk Regiment, the regiment one of my sons was in. I like to feel that the spirit of exploration that took my son away to the Antarctic also made Hamond a good explorer.

The PRESIDENT: Our thanks are due to both the writer and the reader of the paper for a most interesting afternoon. We also thank Colonel Ryder for his contribution. We have spent a very profitable afternoon, and I am sure we are grateful to all three for what they have told us.

THE SARGASSO SEA

G. E. R. DEACON

PROFESSOR KRÜMMEL, who has studied the history of the Sargasso Sea, found that it was discovered by Columbus, who makes frequent references to the drifting weed in the account of his westward voyage in 1492; on some days little or none was seen, but at other times large expanses, and on one occasion the sea was so covered that they would have been fearful of sunken rocks if they had not realized by then that the weed floated in deep water. The weed was said to have the appearance of herbs recently torn from the rocks and land, or drifted from rivers; it was described as fresh and composed of young and old plants, and was found to move sometimes from the east and sometimes from the west. They must have examined it closely; the admiral kept one of the small crabs which live among its branches; and he mentions the small berry-like air-bladders which grow on small side branches and make the *Sargassum* species easily recognizable.

The editor of the *Nautical Magazine* in an early article about the weed (1832, p. 175), attributes the name Sargasso to the Portuguese navigators who called the weed *Sargaçao* because of the resemblance of the small air-bladders to a small species of grape which they knew by the name *sarga;* when the article was written the weed was sometimes known as tropical grapes, but usually as gulf-weed or Sargasso weed. According to Krümmel the name was used first by the Spanish historian Oviedo, who went to the West Indies in 1514; it became well known during the next hundred years, and Varenius, in his 'Geographia Generalis,' published in 1650, mentions "the famous region called by the Portuguese *mare di Sargasso.*"

Major James Rennell (1832, p. 27) assumed that the weed was brought from the Gulf of Mexico by the Gulf Stream, but Baron von Humboldt was inclined to believe that it was produced on vast beds at the bottom of the ocean from which it was detached in a ripened state; he emphasized the fact that the weed south-west of the Azores appeared fresh and in full vegetation as if it had been newly torn from the rocks, and protested that the sounding-lead had not been used enough in the areas rich in weed. His opinions never found much support; they are discredited in the article in the *Nautical Magazine*, which favours the alternative explanation that the weed is carried with the current through the Straits of Florida; its main authority is given as a study of the question by Sir Hans Sloane in his 'Natural history of Jamaica' (1707), but the same opinion is described as generally held among sailors.

No one seems to have paid serious attention to the possibility that the weed might grow as it drifted, till the German botanist Meyen (1834) put forward the theory that the plants had never been attached to the sea-bed or rocks. His views were the more striking because his thorough investigation, made during the visit of a training ship to the region, showed that all the drifting plants were sterile, completely lacking the reproductive organs by which they multiply during their normal life attached to a rocky coast-line. The indications of recent growth were so strong that he could not believe that the plants had drifted all the way from the Gulf of Mexico, and though they were once

derived from beds of attached weed in that region, he argued that they must now grow as they drift in the Sargasso Sea, not by the normal method of reproduction of attached weeds in which female egg cells are fertilized by some of the more numerous male sperms and fall to some suitable ground, but by an alternative method of vegetative reproduction which has become secondarily normal to them: fragments broken from the drifting plants by wave action or by the breaking up of an old plant grow, like the cuttings of many bushy plants, till they are as large as the original. He thought such growth had been going on for thousands of years, and his final conclusion was that the total quantity of weed is constantly increasing.

This theory of vegetative growth received a good deal of support, but it was often rejected, mainly because of a reluctance to believe that a plant could live indefinitely without recourse to normal reproductive processes. Kuntze, in what Professor Winge (1923) shows to be a rather unreasonable paper, states that the plants could not live more than three months once they were detached from the rocks, and though the scientists in H.M.S. *Challenger* were not so emphatic, they did not think that the plants could multiply or keep afloat very long. Murray and Hjort (1912) describe the reproduction by partition as abnormal, and say that vegetative growth produces thinner branches with fewer bladders, so that the plants tend to float lower in the water than newly detached plants, and soon the power of floating will cease altogether; they add that the disappearance of the weed would be imperceptible since fresh patches are constantly arriving from the coast.

Professor Winge thoroughly discredits a statement made by Kuntze as late as 1881, that there was not enough weed in the Sargasso Sea to distinguish it from the rest of the ocean, and that you could sail through it for days without seeing more weed than you would in the North Sea. The statement does not bear looking into, but it has left some impression, and Parr (1939) deplores its reappearance in a work on Algae published as late as 1935 by J. E. Tilden at the University of Minnesota. In contrast, the writings of Oviedo mention large green and yellow meadows, and Humboldt insists that there is a great accumulation of weed which had remained in essentially the same position since it was discovered three and a half centuries before. The modern investigators seem still to have had some obligation to show that there was enough drifting weed to mark the region unmistakably, though their chief concern has been the problem of its growth—whether it is an aggregation of slowly perishing individuals or a self-sustaining community.

Most of the recent information is contained in the reports already mentioned, by Professors O. Krümmel, of the Deutsche Seewarte; Ö. Winge, of the Royal Agricultural College, Copenhagen; and A. E. Parr, of the Bingham Oceanographic Laboratory, Yale. They have shown that even where the weed is most abundant its amount is very variable, but a ship cannot sail for long without sighting a patch of some kind: at one time it may be as long strips lying in the direction of the wind, or large floes several hundred yards across, while at another there will be only individual plants or small fragments. Winge, whose report is based largely on the observations of Danish expeditions, quotes a letter from the master of a merchant vessel, who describes the greatest accumulation of weed he had seen as a sea-weed floe so extensive that

no open water could be seen on any side, and so compact that the weed closed together again a few hundred yards behind the ship. Such conditions are however exceptional, and the most striking occurrence of weed that Winge could find among the remainder of his records was of a narrow strip of weed at least 3 to 4 miles long seen by a Danish scientist. Professor Hentschel, writing of two voyages between the Azores and the West Indies (Schott, 1926, p. 291), says that drifting weed was almost always visible, though the amount varied greatly; he usually saw it as long strips, and less often in large or small patches. Counts made three times a day gave an average of 12,000 plants per square kilometre, or one for each 100 square yards. Professor Parr towed a specially designed weed-collector from the American research vessel *Atlantis* covering 7000 miles altogether, and just over 1300 in the Sargasso Sea proper, and he found the average weed density in the Sargasso Sea during the years 1933, 1934, and 1935 to be 3^1_2, 5, and 2 tons per square mile.

There seems to be no foundation for the belief that the masses of weed can be large and heavy enough to hinder the passage of a ship, and even in the heart of the region the sea is open and the weed offers no obstruction. It has sometimes been described as rafted together so that some of the upper shoots stand notably above the surface of the water, but all Parr's work indicates that it floats shallow at the surface; when the weed-collector was towed for 24 miles at a depth of 5–6 feet through a region with plenty of weed at the surface the catch was negligible—only a few fragments which most probably entered the apparatus while it was being lowered and raised.

The *Sargassum* weed is not a large plant and single specimens vary in size from fragments of an inch or two to bushy plants about 12 inches long. Some 89–99 per cent. belong to two main varieties *Sargassum natans* and *Sargassum fluitans*; four to six other forms are recognized, but the literature shows some uncertainty about classification and nomenclature; there are many intergradations between them, and it is not clear whether these must be regarded as a large number of species with small differences, or a few which vary over a wide range. The plants are usually covered with a variety of encrusting organisms, some of the most common being members of the Bryozoa (whose name means moss-animals), Hydroids, resembling colonies of minute anemones, and Spirorbis: a small worm with a flat spiral shell. The colour of the weed is said to vary from light olive-green in the upper shoots to brown in the lower parts; Krümmel described it as olive-yellow and golden-brown, contrasting in a charming way with the unbelievable transparent cobalt blue of the tropical water. Winge describes how the weed tends to subdue the waves, and seen from a distance in a breeze the *Sargassum* flotillas lie like smooth strips in contrast to the ruffled surface of the surrounding ocean.

Arguments summarized by Winge and Parr now leave little doubt that the drifting weed population is essentially self-supporting; it has been built up during centuries and perhaps thousands of years from plants drifted from the West Indies and by vegetative growth *in situ*, but the annual contribution of new weed from the West Indies is likely to be small; most of the plants in the Sargasso Sea have grown vegetatively and are able to multiply themselves indefinitely by partition. There are no direct measurements of the vegetative

growth, but there are so many descriptions of healthily coloured budding leaves and branches, and vigorous older parts, that the evidence is almost conclusive. Further indications have been obtained from a close examination of the encrustation on the weed: the slowest-growing organisms are found concentrated on the lower parts of the plants, while the more active species form the main covering of the upper parts. The end shoots are often free from encrustation altogether, and it is reasonable to suppose that their growth is too recent for the encrusting organisms to have gained a hold on them. Each species of encrusting organism has been found to show a preference for some particular variety of the weed, probably because there is a favourable relation between their growth rates (Burkenroad, Parr, 1939, p. 25).

Neither of the main forms of the drifting weed has so far been identified with any species collected from the shores of the West Indies or neighbouring coasts, and since these are fairly well known it has been argued that the weed while drifting must have changed its appearance, probably over a long period. The argument has perhaps been weakened by Professor Parr's discovery of a single specimen of *Sargassum fluitans* in a fertile state and otherwise no different from the widespread drifting form, attached to a piece of drifting mangrove root; but the specimen cannot be identified with any of the known West Indian forms, and if it does give a first indication that the difference between the drifting and attached plants is not as great as first supposed, it must also show that the attached species concerned is of very rare occurrence.

Professor Parr has carefully considered the question of the origin of the drifting weed, and he finds that there is no field of growing weed large enough to keep the Sargasso Sea fully supplied unless the weed grows and multiplies extensively as it drifts; he shows that the supply cannot be a tenth of what is necessary, and decides that the life of the drifting plants must be reckoned in tens of years if not in hundreds or thousands. He has shown that the Caribbean Sea south of Jamaica and Honduras is empty of weed, which excludes the coasts of the Lesser Antilles and South America as possible sources, and leaves only the larger northern islands as well as the banks between Jamaica and Honduras, the Gulf of Mexico, Florida, and Bermuda. Any weed from most of these localities will take six months to drift to the northern part of the Sargasso Sea, and several years to drift all round it.

The ocean currents of the North Atlantic must be largely responsible for the accumulation of weed. Since the time of Rennell and Maury it has been known that the weed is concentrated mainly in an almost currentless region in the centre of the great anticyclonic eddy formed by the Gulf Stream and its continuations, the trade-wind drift and the North Equatorial Current. Owing to the combined effect of the wind, earth's rotation, and friction, the water of any ocean current has some lateral circulation, at right angles to the main direction of forward movement. A vertical cross-section through a current in the northern hemisphere, seen in the direction of the current, shows that the light water at the surface tends to move to the right of the current, and to accumulate there, against some other water mass or natural boundary, till the density surfaces slope downwards steeply enough for the forces which tend to restore them to the horizontal to be strong enough to balance the effect of

the earth's rotation; and in the wedge-shaped layers produced by such an equilibrium there is a tendency for the water to circulate in a clockwise direction, sinking on the right of the current, and returning to the left by some practicable path at a depth which depends on the density distribution and the depth to which the direct influence of the wind penetrates.

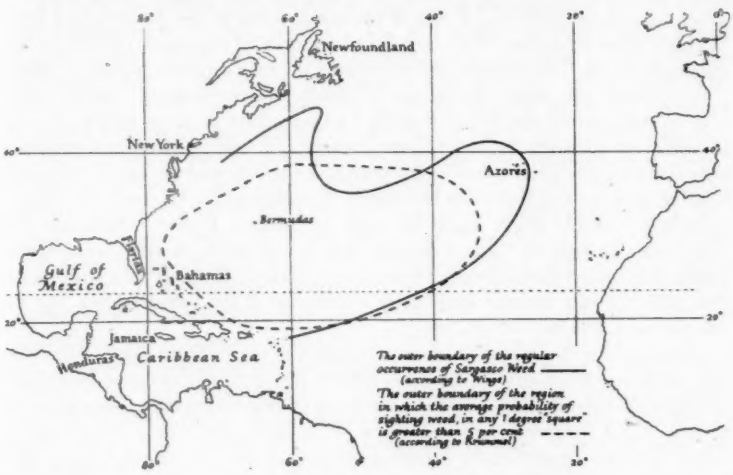
In the large anticyclonic current system round the Sargasso Sea the density surfaces slope downwards into the almost currentless central region, and below the weed concentration there is a large accumulation of warm water shaped something like a lens, elliptical rather than spherical, and very flat; the surface of the sea is probably 2 feet higher in the middle than round the edges, and an indication of the depression of the density surfaces is given by the fact that water warmer than 10° C. penetrates to a depth of some 500 fathoms in the central region as against 100–200 fathoms round the outside. There is some evidence that the large core of warm water expands and contracts as the currents round it grow weaker and stronger, but in general there is likely to be a weakly predominating movement towards the central region. Some indication of the slowness of the transfer of weeds across the Gulf Stream is pointed out by Parr, who shows that some forms of *Sargassum* weed which are known to be short-lived are not able to gain a footing in the Sargasso Sea though they are fairly common in the Gulf Stream, and it seems most likely that only a relatively small proportion of the weed carried by the current reaches the Sargasso Sea.

To obtain a simple picture, it must be remembered that the great accumulation of warm water in the Sargasso region was first built up in the era when the ocean currents developed, and now it is stabilized by them, its area and volume depending to a large extent on their activity. But if it is not wise to stress too much the tendency of the weed to drift towards the central region, it is safe to describe the current system as one which is more favourable to the accumulation of drifting material than to its dispersal.

Danish research vessels have made some experiments with drift-bottles, carefully made water-tight, and weighted with sand till they floated low in the water (Winge, 1923); of three hundred and fifty-five of these bottles thrown overboard in the Sargasso Sea, only seven have been drifted ashore and recovered, whereas of one hundred and eighty liberated outside the sea, twenty-four have come to hand. The figures give a rough indication that the bottles drifting in the Sargasso Sea have only one-seventh the chance of drifting ashore, and their probable fate is to drift about till they are so overgrown with barnacles and other organisms that they sink. The records from the bottles which have been recovered suggest that the time taken for an object to drift right round the Sargasso Sea is two to three years, and there is a saying in Bermuda that floating objects will come back after three years. The main avenue of escape from the current circle seems to be towards the north in the Gulf Stream. The schoolboy stories of lost ships, drifting for years, are not altogether without foundation. Schott (1926) describes the drift of a schooner *Fanny Wolston*, left derelict with a cargo of timber in the northern part of the Sargasso Sea in 1891, and reported forty-six times during the next three years while she circled the whole region; for a year she drifted about, south-west of the Azores, then moved south and west to the region between the Bahamas

and Bermuda, and was last seen about 400 miles N.N.E. of Bermuda in the Gulf Stream.

The first organized attempt to determine the average geographical boundaries of the drifting weed seems to have been made by Captain Leps, who examined numerous log-books of French vessels in 1865 (Krümmel, p. 133), but a more comprehensive investigation was made by Professor Krümmel, who based his work on the records of weed sighted by German ships and entered in their log-books as required by the Deutsche Seewarte. For each small area bounded by a degree of latitude and longitude he divided the number of times weed had been recorded by the number of times ships had crossed the area, and then took an average for the twenty-five such areas contained in one bounded by 5 degrees of latitude and longitude. His final results show the average probability of weed being sighted in any 1-degree


Newfoundland
New York
Azores
Bermudas
Florida
Gulf of Mexico
Bahamas
Jamaica
Honduras
Caribbean Sea
The outer boundary of the regular occurrence of Sargasso Weed (according to Winge)
The outer boundary of the region in which the average probability of sighting weed, in any 1 degree square is greater than 5 per cent (according to Krümmel)

element of the specified 5-degree "square," and they have been calculated for each season and for the whole year. The year's figures are used to make a chart showing probability or frequency contours for 10, 5, 1, and 0·3 per cent. The chart is not altogether reliable because figures were only available between 20°–50° N. and 30°–50° W.; outside these limits it was extended as well as possible from isolated observations and the earlier chart by Captain Leps, and it does not agree very well with a continuation of Krümmel's calculations by Antze (Winge, p. 9); but it allows a passable comparison between different parts of the region, and since the weed is now known to show an extreme degree of variability in both quantity and position, it is likely to be as good a guide as will be obtained till much more work has been done.

Krummel's chart might be modified slightly because of a later one constructed by Winge, who used semi-quantitative figures based on hauls with tow-nets; his map indicates the size of each sample by the size of the dot which

marks the position where it was taken, and he has drawn a smooth line as faithfully as possible through the points at which weed was found and those at which the net was empty; his line can be regarded as the outer boundary of the regular occurrence of the weed. His chart shows that the weed extends farther north-east towards the Azores than Krümmel's does, but it includes part of the Gulf Stream, which, though it does carry some weed, is usually regarded as a separate natural region. It is probably better not to attempt a very precise definition of the boundaries of the Sargasso Sea, and the name is likely to be most useful when it is applied in a general way to the central region between the Gulf Stream with its continuations, and the trade-wind drift and North Equatorial Current; it is roughly an oval-shaped area of about 2 million square miles between the Bahamas and the Azores, and slightly broader at its western end, when it extends northwards to include Bermuda and southwards to 18° N. Such an area corresponds roughly to Krümmel's 5 per cent. frequency line if this is extended towards the Azores, and with Winge's outer boundary of the regular occurrence of the weed, except for his extension in the Gulf Stream region towards the area south of Newfoundland.

Sometimes the small *Sargassum* bladders, whose diameter varies from 2 to 10 millimetres, are found floating by themselves in strips or patches, or in sufficient numbers to make them conspicuous among the weed patches; they have usually been noted in the marginal regions, and are likely to be left floating in some number when the rest of the plant sinks. Professor Krümmel mentions a world chart made in 1436 by Andrea Bianco which has the notice *mar de baga* or "sea of berries" just north of the Azores, west of the position in which they are now known to lie; Krümmel mentions a suggestion that such a notice betrays some early knowledge of the Sargasso Sea, but he has not been able to follow it up.

In discussing the question of the mortality of the drifting weed, Professor Parr says that the plants in the main central region of the Sargasso Sea show no signs of degeneration, and their covering of encrusting organisms is never so heavy that it threatens to sink them. It is likely that some loss will occur when the plant multiplies by breaking up into smaller fragments, because the heavier basal parts are liable to sink when separated from the more buoyant upper parts. It is also possible that some plants may be carried down in the wake of a ship, or by wave-action during a violent storm, to a depth at which they may lose buoyancy through compression of their air-bladders, but the chance of this happening is believed to be small.

The greatest danger to the weed lies in the marginal regions, especially in the north-west and north; in these regions, though there may still be plenty of healthy plants, even in winter, many are dark brown and battered, having lost a considerable proportion of their leaves and bladders, and showing little indication of fresh growth. Winge maintains that the weed cannot thrive in water colder than 18° C.: growth gradually ceases and the plant becomes sickly, and the encrusting organisms soon grow faster than the plant itself, weakening its power of assimilation still further till after a while it must sink. Parr does not think that sea-temperature is necessarily the most important factor, and stresses the killing power of cold winds which attack the partly exposed upper shoots, but he furnishes more evidence for the conclusion that

the drifting of the weed into colder regions is its greatest danger. Unhealthy specimens are taken in the region between Bermuda and New York, especially in winter, and further movement to the north-west is still more fatal. Krümmel mentions a few records of the sighting of the weed north of 45° N. in summer, but it has never been seen so far north in winter. Parr concludes that the plants which stand in greatest danger are those newly detached from the rocks, because the Gulf Stream is likely to carry them northwards to the latitudes of cold water and killing north and north-west winds, without their being able to reach the comparative security of the Sargasso Sea. Summarizing the latest information he gives good reason to suppose that the drifting weed in the Sargasso Sea receives only a small annual contribution of detached weed to compensate for its loss through excess of mortality over vegetative growth.

In order to explain fluctuations as large as those suggested by the differences between Parr's figures of $3\frac{1}{2}$, $5\frac{1}{2}$, and 2 tons per square mile for the average density of the weed in the years 1933–1935, it must be assumed that the conditions which govern the growth and mortality of the weed vary enormously. Parr does not however quote the figures without reservation, since his hauls were made mostly in the western half of the sea and the centre of abundance may move eastwards or westwards. His observations as a whole show an extremely high degree of variability in the concentration of weed, which discourages the drawing of early conclusions about changes in the total quantity till many more observations have been repeated over the whole area.

It is possible that some information may be obtained by comparing Parr's figures with those recently published by Iselin showing changes in the water transport of the Gulf Stream between 1932 and 1938. Arranged in order of decreasing water transport these years follow the sequence 1934, 32, 38, 33, 36, 35, and 37, and the year 1934 when there was most weed was the year of strongest current, while 1935 with least weed had almost the weakest current, and the figures for 1933 stand half-way between. The comparison cannot be made over a long enough period to prove any relation, but it suggests that there may be a high weed density in the Sargasso Sea when the Gulf Stream is strong and a low density when it is weak. Such a possibility is in good agreement with views put forward by Iselin (1938), who supposes that the whole current eddy round the Sargasso Sea tends to expand when the currents are weak and to contract when they are strong; weak currents would therefore disperse the weed to some extent into the marginal regions, and strong currents would concentrate it in the central area. It is also reasonable to suppose that the rate of recruitment of newly detached weeds will be influenced by changes in the Gulf Stream, and that Parr's observations, which are mainly in the western half of the Sargasso Sea, might be particularly affected by them.

The question of seasonal changes has been discussed mainly on the basis of the figures calculated by Krümmel, which show that the weed is sighted least frequently in summer and most frequently in autumn, the average increase of probability between 20°–50° N. and 30°–50° W. being 1 per cent. Winge believes that the increase of frequency is due to the more vigorous growth of the weed during summer, but Parr takes a different view, and does not admit that the more frequent sighting of the weed proves that it is more abundant,

arguing that the weed is sighted less frequently in summer because it tends to associate into larger units in calm weather; he agrees with Winge that growth is likely to be most rapid in the calm summer weather, but says that the stronger autumn winds will find the plants in a condition when they are most easily broken up and will disperse large patches into smaller scattered units. Krümmel showed that the weed made more progress to the north-west in the Gulf Stream region in summer than in winter, and thought that there was an autumn increase, starting first in the north-west and spreading east and south later; he supposed it to show that a wave of newly detached plants was carried northwards every year in the Gulf Stream, but this is now almost discredited. Winge regards the greater northward progress at the end of summer as due to a tendency of the wind to blow from the south-west in summer and from the north or north-west in winter, and Iselin (1940) has shown that the Gulf Stream is strongest in July or August. Conditions undoubtedly become more unfavourable for the weed in winter; the dangerous northern marginal region extends farther south, and it is very likely that the increase in the trade-winds round the southern margin will cause more weed to be thrown ashore in the south-west.

Workers at Plymouth have estimated that the annual crop of plant life in the water of the English Channel is about 5000 tons per square mile, an enormous figure compared with the 2–5½ tons of Sargasso weed per square mile. It is not to be expected that the surface water of the Sargasso Sea could grow as large a crop as the English Channel because it is known to contain much less phosphate and nitrate; but the sunlight penetrates to a much greater depth, so that plant life can be maintained at a deeper level, where there are larger concentrations of nutrient salts, and taking this into consideration Seiwell (1935) and Riley (1939) have evidence that the total plant production below each square mile of the Sargasso Sea is likely to be of the same order as that of the temperate waters. Murray and Hjort (1912, p. 718) used the presence of the weed and its consequent rain of detritus to explain why the animal life in the deeper levels was richer in the western half of the ocean than in the eastern half, but Professor Parr shows that even if the weed was to produce ten times its own weight every year, and it may be only a fraction of this, it would only account for a hundredth of the total annual production of plant life, by far the greater proportion of the crop being microscopic diatoms, and it is not likely that the weed plays any appreciable part in the total metabolism of the ocean.

The aspect of the Sargasso Sea which has brought it most into prominence during the past twenty years is its discovery by Professor J. Schmidt (1933) as the breeding place of the common European and North American freshwater eels. Among the millions of eels taken every year from European rivers no captures were ever made of sexually mature individuals or of eggs and young larvae, and it was not till advanced larvae were first recognized in townettings off the continental slope west of Europe, and younger and smaller larvae gradually traced back to a depth of 200–500 metres in the Sargasso Sea, that the problem of their spawning was solved. When the eel is ready to spawn it makes its way down the rivers and across the ocean; it is not known how long the journey takes, but the spawning occurs in winter and early

spring, and as far as is known at present the spent eel dies. The young larvae spread northwards and appear off the coasts of Europe about two years later; they then undergo a change from the ribbon-like larvae about 75 millimetres long to the somewhat shorter eel-like creature known as the elver which ascends the European rivers, often in great quantities, and finally invades all stretches of fresh water which promise a livelihood. It is not likely that the presence of the drifting weed has anything to do with the choice of the region for spawning; the nature of the surface and deep water currents, and the presence of a deep-reaching accumulation of warm water are probably much more important.

But although the weed has no great influence on the normal plant and animal life of the ocean it has a peculiar fauna of its own which well deserves comment, composed mostly of small crabs, naked molluscs, and small fishes which belong to the seashore rather than the open sea and depend on its shelter. Murray and Hjort emphasize the intimate adaptation of this fauna in colour and shape to a life among the weed. They describe a specimen of the sea-horse whose body was reddish-brown, something like the weed, while its fins, which have to be moved freely in the blue water, were blue; the small crabs also exhibit all the varieties of the colouring presented by the weed. The prehensile organs of the pectoral fins of the small fish *Antennarius marmoratus* are quoted as another example; the fins can be used as limbs which allow the fish to climb about in the weed, earning for it the name frog-fish, toad-fish, or monkey-fish. The number of animals in the weed would not be suspected till they are shaken out of it. Winge has pointed out another interesting use of the weed, by the flying-fish: the weed is sometimes bound tightly together by egg-strings of this fish into bundles which may be as large as footballs, and that chosen for the bundles belongs almost entirely to two varieties having very small bladders which match the eggs.

The climate of the Sargasso Sea is for the most part one of calms, light winds, and fine clear weather. Columbus, on the day when he first sighted weed, said that then and ever afterwards they met with temperate breezes, so that there was much pleasure in enjoying the mornings; he says that the weather was like April in Andalusia, nothing being wanted but the song of the nightingales, and he often mentions the sea as smooth as a river. The prevailing winds blow roughly clockwise round the central region, which is an anticyclonic area of high pressure between the trade-winds and westerlies; it is often referred to as the Horse Latitudes, because ships carrying horses to the West Indies or America sometimes found it necessary to throw them overboard when too long becalmed. The marginal regions are affected to some extent by the climates of the neighbouring currents; in the south-east the weather is fine and dry, and in the west it can be influenced by the violent storms and hurricanes which are largely the result of the great temperature contrasts between the Gulf Stream region and the coasts and interior of the American continent. Rennell (1832) says that a ship might save a distance equal to four days' sail by keeping to the favourable current of the Gulf Stream, but the advantages gained did not compensate for the wear and tear occasioned by rough weather, and in the view of experienced navigators it was advisable to steer eastward out of the current as soon as the trade-wind

region had been cleared. Rennell also quotes the findings of an Admiralty inquiry, that most of the heavy and disastrous gales of the North Atlantic happen either within or on the verge of the Gulf Stream water. Professor Schott (1926) describes the climate of the Gulf Stream region as one of paralysing moist heat, and the western part of the Sargasso Sea must sometimes fall under the same influence.

The temperature of the surface water in the Sargasso Sea varies from 17° C. to 23° C. from north to south in winter, and from 23° C. to 27° C. in summer, and the isotherms run mainly east and west. Especially in the south-east it is a region of high evaporation, and the salinity of the water in the central region is as much as 37·3–37·5 parts per thousand. The water is remarkable for its transparency, and Schott found that a white disc 2 metres in diameter could be seen at a depth of 66 metres; he attributes the clearness of the water to its distance from land, but the modern interpretation would be that it is due to the comparative absence of minute plant and animal life in the upper part of the water column, and Riley has shown that the greatest density of such plant life occurs at a depth of 100 metres, whereas in water with plenty of nutrient salts it would be found much nearer the surface.

Most of the previous descriptions of the region have emphasized the great uniformity of its water, so that temperature and salinity surfaces are parallel and level over long distances; but the recent observations of the *Atlantis* are more closely spaced and reveal unsuspected irregularities at the surface. There is no steady current except a slow resultant tendency to circulate in a clockwise direction, but there is evidence of variable local movements. Movements set up by the wind will be countered to some extent by the forces which tend to keep the light surface water spread evenly over the deeper water, and the two influences reach an unsteady equilibrium, setting up sharp boundaries of a minor character which are likely to be marked by a narrow zone of current; every change of wind will give rise to complex small-scale movements which may not be revealed by temperature and salinity observations at the surface, because they take place largely in water of uniform temperature and salinity. The patchiness of the weed distribution is therefore not out of conformity with the water movements, and it must also be recognized that weed can, to some degree, move independently of the surface water.

There is a secondary accumulation of weed in the Gulf of Mexico. Professor Parr estimates that it covers roughly one-twentieth of the area of the Sargasso Sea with an average density of 1 ton per square mile. The main reason for its existence is believed to be the easterly winds which take weed from the main current leaving the Caribbean Sea between Cuba and the Yucatan peninsula and trap it in the inner part of the gulf. The weed accumulation is not continuous with that of the Sargasso Sea, there is no comparable abundance in the intervening waters, and no evidence of a movement of gulfweed towards the southern tip of Florida. The weed populations of the two regions themselves show important differences. Parr describes the weed in the Gulf of Mexico as being in an unhealthy state in contrast with that of the Sargasso Sea; it is generally in smaller fragments and the larger pieces have usually lost bladders, leaves, and branches, and in the innermost part of the gulf it is found in almost dying condition. The greater deterioration of the

weed is accompanied by a heavier growth of encrusting organisms, appearing heavy enough to cause the plant to sink. Parr states that a sample of weed from the Gulf of Mexico could always be distinguished from one taken in the Sargasso Sea; the weed population seems not to be self-supporting to the same extent, but rather a stagnant accumulation of slowly perishing individuals, and Parr thinks that the cold winter storms frequent in the Gulf of Mexico, but showing no marked effect on the water temperatures, contribute largely to their destruction. About 85 per cent. of the weed belongs to the variety *Sargassum natans* and this, at least, shows no more evidence of being recently derived from attached plants than it does in the middle of the Sargasso Sea.

There is no similar weed accumulation in the other oceans, and Krümmel argues that nowhere else is there such a favourable combination of weed-beds (which must be the ultimate source of drifting weed) and strong current as is formed by the islands and reefs of the West Indies and the Gulf Stream; there are islands and reefs in the South Pacific Ocean but no strong current to carry the weed to the calm region between the trade-winds and westerlies, nor a well-developed anticyclonic eddy for it to collect in; in the South Atlantic there is the strong Brazil current and a well-developed anticyclonic current system, but the Brazilian coast probably does not grow enough weed. In the Southern Ocean all the coasts and islands between the subtropical region and the latitudes of heavy pack-ice grow large areas of kelp, mainly *Macrocystis pyrifera*, an enormous plant which can grow to a length of 600–700 feet. The weed beds often extend several miles off shore and are notably thick round the Falkland Islands, where Vallentin (Boyson, 1924, p. 379) describes a heap of weed 250 yards long, 15 feet wide, and 6 feet high, thrown ashore in a single cove. But though drifting plants are often encountered, especially in the west wind drift, they are widely scattered.

The literature about the Sargasso Sea is not very accessible, and even the main facts have remained rather obscure. It seems a pity to rob the region of its mystery, but Parr, Winge, Krümmel, and earlier workers to whom it is feared this summary does scant justice, have left a wealth of fascinating information and have opened up many new fields of inquiry. Most of the unsolved problems deal with the recruitment of new weed, rates of growth, and mortality, fluctuations in the position and abundance of the drifting patches, and with matters of classification and nomenclature. The origin of the weed is now determined within fairly narrow limits, but it is not known which are the attached *Sargassum* species mainly concerned, nor how much the recruitment of the drifting population by plants torn from the coast-lines in the neighbourhood of the West Indies goes on actively to-day or is a matter of past evolution, nor at what stage the plants begin to practise reproduction by partition. The suggestions for further work include controlled experiments with uprooted coastal forms and typical drifting plants fastened down, and more repeated observations are wanted from all parts of the sea to obtain real information about the changes in weed density. The results would probably give information of fundamental importance to research on the growth of many other species of seaweed, and just now they might have been of considerable practical importance.

REFERENCES

Boyson, V. F. 'The Falkland Islands.' Oxford, 1924.

Iselin, C. O'D. "Problems in the oceanography of the North Atlantic." *Nature* (141 (1938) 772–776). "Report on the variations in the transport of the Gulf Stream System." Papers in *Physical Oceanography and Meteorology*. Mass. Inst. of Technology and Woods Hole Oceanographic Inst., VIII, No. 1, 1940.

Krümmel, O. "Die nordatlantische Sargassosee." *Petermanns Mitteilungen* (37 (1891) 129–41, Taf. 10).

Meyen, F. J. F. 'Reise um die Erde in den Jahren 1830, 1831, und 1832.' Berlin, 1834.

Murray, J., and Hjort, J. 'The depths of the ocean.' London, 1912.

Parr, A. E. "Quantitative observations on the Pelagic *Sargassum* vegetation of the western North Atlantic." Bulletin of the *Bingham Oceanographic Collection* (VI (1939) 1–94, art. 7).

Rennell, J. 'An investigation of the currents of the North Atlantic Ocean.' London, 1832.

Riley, G. A. "Plankton Studies II: The western North Atlantic." *J. Marine Research* (II (1939) 145–62, No. 2).

Schmidt, J. "Danish eel investigations during 25 years." Carlsberg Foundation. Copenhagen, 1933.

Schott, G. 'Geographie des Atlantischen Ozeans.' Hamburg, 1926.

Seiwell, H. R. "The annual organic production and nutrient phosphorus requirement in the tropical western North Atlantic." *J. du Conseil pour l'exploration de la Mer*, X, No. 1. Copenhagen, 1935.

Winge, Ö. "The Sargasso Sea, its boundaries and vegetation." *Rep. Danish Oceanographical Expeditions*, 1908–10, III, Copenhagen, 1923.

Reference has also been made to an article "Sargasso weed," *Nautical Magazine* (I (1832) 175–79), presumably by the editor, and to "The journal of Christopher Columbus," translated by Clements R. Markham for the *Hakluyt Society*, No. 86, 1893.

WESTERN FRONTIERS OF LIBYA

K. S. SANDFORD

Meeting of the Society, 19 January 1942

I HAVE been invited to read before the Society a lecture which may be regarded as a sequel to "Libyan Frontiers." [1] I have the same objects in view, but wish to make clear at the outset that I have not travelled in western Libya, my interest in the region for several years has been primarily its geology.

A brief account of the twentieth-century history of Libya as a whole was given in "Libyan Frontiers," and the rest of that lecture was devoted to a view of the stage on which a campaign might be set. When it was read, the Italian Army possessed the initiative: when it was published—only a month later—the Army of the Nile was sweeping westward. By the time these notes are read probably the Eighth Army will have penetrated far in Libya. The lecture however is not harnessed to the fortunes of war: it is intended solely to describe in general terms Libya's frontier with the French empire in Africa and the country and communications adjacent to that frontier, as the paper which preceded it described the contact of Libya with the British sphere. The western marches seem to be little known in this country.

Issues in western Egypt were essentially military, but in western Libya they are confused by political considerations that affect not only Africa but Europe and the Atlantic. Clearly it is beyond the scope of this lecture to consider international politics, or politics of any sort, except in so far as they dominate the relative positions of Allies, Axis, and French Africa. The military problem, in its rudimentary state, is to seek and destroy the enemy, but the task may be helped or hindered by political expedience.

The main issues of this lecture are thus twofold: the nature of the country over which troops may operate, and the general plan of its communications. As the coastal zone of Tripolitania has already been described in the *Journal*,[2] these notes will be devoted rather to the interior. The western frontiers are with French territory throughout: French Equatorial Africa and West Africa in the extreme south-west, the Military Territories of Algeria (Sahara) in the west, Tunisia in the north-west. Italy occupied Libya during and after the war with Turkey in 1911–12, her troops entering Murzuch and Gat in 1914. Driven back to the coast during the war of 1914–18, the Italian Army only regained these two towns and the Fezzan in 1930.

Nature of the country.—There are striking differences between the geology and physical features of eastern and western Libya: the dividing line runs conveniently from the Gulf of Sirte at about El Agheila to the northern prolongation of the Tibesti massif known as Jebel Eghei. Eastern Libya is inseparable from the western desert of Egypt as a region of monotonous

[1] *Geogr. J.* 96 (1940) 377.

[2] See E. J. Russell, *Geogr. J.* 94 (1939) 273; also 96 (1940) 377.

plains and plateaux, featureless, bare, windswept, burdened by the Sand Sea which sprawls across the Egyptian frontier from the huge dune area that lies between Siwa and Gialo. In fact, the monotony of eastern Libya is perhaps even more marked than that of western Egypt because the western margin of the Eocene limestone plateau, with its patches of very rough going for motor vehicles, bends sharply northward under the Sand Sea. West of that feature the Nubian Sandstone and associated sands, sandstones, and pebble beds, stretch from the northern end of the Chad basin and the north-western Sudan to the northern limits of the Kufra–Tazerbo region, whence pebble beds indistinguishable from the Nubian Series continue to the line of oases from Giarabub to Marada. North of that line they are succeeded by the Miocene marls and limestones of Cyrenaica, which extend also as a narrow coastal belt westward along the Gulf of Sirte.

An enormous sand-dune area lies between Kufra, Tazerbo, and the prolongation of Tibesti (J. Eghei).

On the whole, western Egypt and eastern Libya afford tolerable going for motor vehicles, with bad patches of rocky and boulder-strewn ground and sand dunes. They are to be regarded in general as waterless, the scanty population being concentrated in a few widely separated oases (except in northern Cyrenaica). Western Libya, on the other hand, although it contains vast areas which are equally waterless and uninhabited, is, by comparison, to be considered as a well-watered region. It is supplied, especially along certain wadis and depressions, by thousands of wells and other sources of drinkable water. Native communications and the population are concentrated along these lines (except in the better-watered parts of Tripolitania), and the country is easier to traverse on this account than are the eastern plains.

Jebel Eghei recalls the 'Uweinat–Gilf Kebir country. In the south, adjoining the main block of Tibesti, are massive sandstones such as appear in Erdi and Ennedi (western Sudan), flanked on their western side by ancient gneisses, schists, granites, such as outcrop in and around 'Uweinat. The sandstones run northward in a narrowing ridge more than 3000 feet above sea-level, twice the altitude of the surrounding plains. On the east and north sandstones scarcely less massive and reaching similar altitudes are banked against those which are geologically older, the whole forming a succession of older and younger Palaeozoic, and finally Mesozoic, strata, for the greater part of continental origin.

This great bastion separates the Kufra–Chad plains from a remarkable tract of country that runs from French West Africa north-eastward across a rugged ridge between Tibesti and the Ahaggar–Ajjar massifs to the Fezzan.[1] The surface consists primarily of sandstones and pebble beds encumbered by vast areas of wind-blown sand. One such sand-dune region lies between Tummo and Murzuch. On its western side, between In Ezzan and Gat and stretching westward to the Ahaggar–Ajjar, rise the Tassili escarpments, massive sandstones, many of them of the same geological age and type as

[1] See Conrad Kilian, *Geogr. J.* 86 (1935) 17. A general account of this country, from a geological point of view, together with a considerable list of references to literature, will be found in "Observations on the Geology of Northern Central Africa," *Quart. J. geol. Soc. Lond.* 93 (1937) 534.

those of J. Eghei, Tibesti, Erdi, Ennedi. The escarpments and their rugged plateaux run westward some 600 miles into the French Sahara, surrounding the huge mountain massif of the Ahaggar, which is crowned by now extinct volcanoes.

For the greater part the Tassili scarps and mountains are barren rock, but rainfall is abundant in some years, flushing the deep wadis which debouch into the surrounding plains and supporting a considerable vegetation in some of them. The wadi Tanezzuft, in which Gat is situated, is one of these, and recent Italian surveys have shown Gat to be well supplied with water. The physical features of this region, through which runs the Franco–Italian frontier, are very clear-cut. First, mainly on the French side, is the main Tassili plateau in which the Tanezzuft rises near the frontier south of Gat. The wadi runs northward to fade out near the junction of the scarp country with the plains, thus forming a deep trench between the Tassili and the next range of mountains, the Acacus Tadrart, on its east side. From this range numerous wadis drain eastward, all of them disappearing in a region of sand dunes, which also runs north and south. A third ridge follows, the Mesach (or Amsach) Mellet, likewise running north and south, rather narrow, giving rise to wadis which drain both west and east sides and disappear beneath sand dunes. All these ridges consist of Palaeozoic strata, most of them of marine rather than continental origin.

From the northern part of the Mesach Mellet a plateau of Nubian Sandstone, the Hamadet Murzuch, runs north-eastward to a point about midway between Sebha and Hun. In its western part broad drainage channels lie on its flanks, the wadi Bergiug on the south and the wadi Irauen on the north, and beyond, on both sides, lie the great basins, sand-dune areas (Edeien, plur. Idehan) of Murzuch on the south, and Ubari on the north. The two wadis are important features: they are joined by numerous wadis from the high ground between them and from the northern prolongation of the Mesach Mellet, and the Irauen in particular traverses a broad area of recent alluvial deposits, is vegetated, and provides an inhabited corridor between the mountainous country around Gat and the southern approaches to Tripolitania. Moreover eastward from Ubari (wadi el Agial, with nearly six hundred wells) and from Murzuch water is at or near the surface and maintains oases arranged in long lines between rocky ridge and sand dunes to points beyond Sebha (over three hundred wells) and Zuila. The region between Murzuch and Zuila: El Hofra, in which Traghen is situated, is especially well supplied with water: there are stated to be over one thousand wells.

The Edeien Murzuch is roughly circular in outline, with a diameter of about 175 miles: Italian maps show caravan routes only across its eastern part between Murzuch and the oases of the district of El Gatrun. The Edeien Ubari stretches westward into French territory; eastward, in Libya, it is broken by a broad area of rock-desert and tapers off to the east beyond Sebha. On its northern side in this region Palaeozoic strata come to the surface once more, forming rocky country. As in the wadi Irauen on the south side, so here are alluvial deposits, drainage channels, and oases between rock and sand: some of the oases are well watered and in the general area of the wadi esc Sciati (with over six hundred wells) to wadi Cneir there is considerable

vegetation. The small town of Brach is the centre of this district. Waterholes, salt pools, and the like occur in the eastern part of the Edeien Ubari, and it is crossed by numerous caravan routes. To the north and east the nature of the country changes radically.[1]

North of Brach the ubiquitous sands and sandstones of the south and east give place to limestones, with associated clays and sands, of marine origin and of Cretaceous and Eocene age. These occupy the whole of western Libya north of Brach and west of Marada, with a great promontory stretching southward in the central part of Libya almost as far as J. Eghei. The eastern plateaux consist of Eocene beds like those of western Egypt, the western limestones are Cretaceous and constitute the Hamada el Hamra, *i.e.* the country west of a line from Hun to Homs. The northern margin of Hamada el Hamra forms the Tripolitanian Jebel, a striking scarp, or series of scarps and hills, running from the coast at Homs due west into Tunisia. Tarhuna, Garian, Nalut, and other important centres are situated upon the scarps and adjacent uplands.

Crowning Cretaceous and Eocene plateaux alike in central Libya are the two huge volcanic regions of the Fezzan, the J. es Soda, traversed by roads from Tripoli and Hun, and the Harug el Asuad, stretching for nearly 200 miles southward from Zella and about 125 miles wide.

South of the Harug el Asuad are small and scattered lava sheets, small extinct volcanoes, and volcanic necks. They mark the region of Uau el Chebir and Uau en Namus. These two inhabited places are of some importance as they provide water between Tazerbo, Kufra, Tibesti, and the Fezzan. The region between them, the Harug el Asuad and Kufra, is of special interest in view of the remarkable operations of the Italian Army for the occupation of Kufra in 1931. A column was concentrated at Uau el Chebir, another travelled *via* Bu Hasciscia (Hashisha) on the eastern flank of the Harug, water being plentiful at both places: these two met at Tazerbo. A third column started from Agedabia (Jedabia) in the north and made direct for Kufra *via* Gialo, converging on the combined force from Tazerbo. Against such strength there could be little effective opposition from Kufra, but the operations were a milestone in the progress of desert warfare on account of the skilful combination of camel and mechanized units.[2]

There are other areas of lava in western Libya, notably in the Tripolitanian Jebel between Garian and Beni Ulid, the latter being situated in one of them.

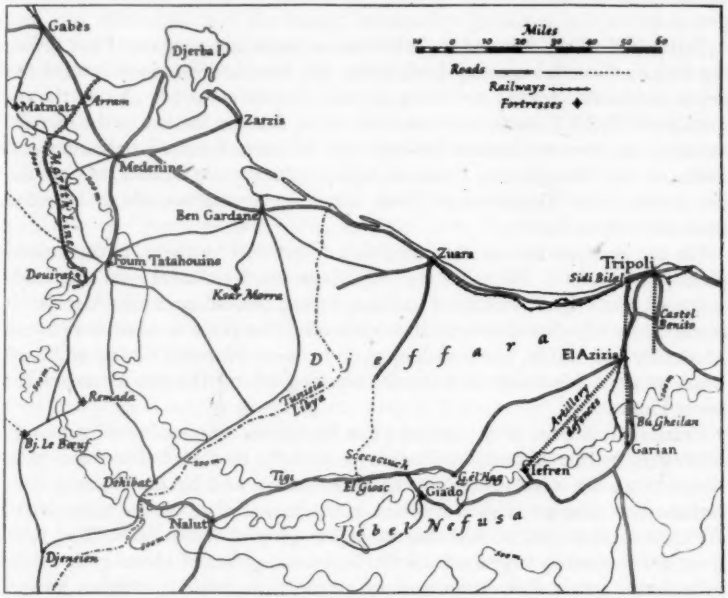
I will conclude these notes on the nature of the country by a more detailed review of the northern part of the western frontier zone.

[1] Technical papers on the Fezzan and Gat appear in 'Il Sahara Italiano,' a volume published by the R. Società Geografica Italiana, Rome, 1937. Useful summaries of the geology also are contained in "Osservazioni geografiche e geologiche compiute della Spedizione della Reale Accademia d'Italia nel Deserto Libico e nel Fezzan orientale (1931)," by A. Desio in Memorie geologiche e geografiche di Giotto Dainelli, Vol. III (1932) 111, and in " Riassunto sulla constituzione geologica del Fezzan," Instituto di Geologia, Paleontologia, e Geografia fisica della R. Università di Milano, Ser. G. Pub. No. 6 (1936) 319, by the same author. For Libya as a whole see especially Desio's recent paper "Le nostre conoscenze geologiche sulla Libia sino al 1938," *ibid.*, Pub. No. 10, 1939.

[2] A good account of this campaign is given by Bagnold in 'Libyan Sands,' London, 1935, pp. 241–51.

The Hamada el Hamra continues westward, south of Gadames, into Algeria, where it is termed the Hamada of Tinghert: it narrows here and is much dissected by watercourses which disappear under the sands of the Grand Erg Oriental (also known as the Zemoul el Akbar) on the north.

The northern sand area is a vital factor in the Tunisian–Tripolitanian defences: it lies along the whole western flank of the Hamada el Hamra, including the north-western prolongation of the plateau into eastern Tunisia. On the north the sands give place below sea-level to the Shotts, salt lakes, salt pans, treacherous mudflats, that lie between the Saharan plateau (Hamada) and the folded chains of the Tunisian Atlas. Sand and shott,



Tunisian–Tripolitanian defences

especially the easternmost or Shott Djerid, are regarded as considerable natural defences against the invasion of southern Tunisia. From the Italian point of view the possession of Gadames at the junction of Hamada and Erg is obviously desirable not only for reasons of internal security but as a southern outpost to the defences of the Tripolitanian Jebel and of the frontier near Nalut.

On the French side of the frontier, south of Tunisia, military measures have been concerned chiefly with internal security. The communications are the routes of the country, for the most part running north and south, some of them passing to ancient centres such as Gat and Gadames by long usage that takes no count of frontiers imposed by Europeans. Of forts there are several, but they may be regarded as survivals from the French pacification of the Sahara, centres of military administration situated on routes at places where

water is available. Two of them are within 100 miles of the frontier, Fort Charlet (Djanet) west of Gat and Fort Polignac in the Ajjar plateau-and-scarp country, but their positions are concerned with internal security. In the southern tip of Tunisia the frontier post of Fort Saint stands opposite Gadames near the edge of the sand dunes.

Strategy in the French Sahara seems to have relied on distance, so far as any threat from Libya might be concerned, and in this, as in south-eastern Libya, south-western Egypt, and the north-western Sudan, it may be regarded as camel-minded. Time, space, food, water, and surface controlled the movements of camel transport, but all these factors save surface seem to be disappearing in African warfare with the arrival of the self-contained petrol-driven and armoured columns of 1941.

North-east of the Zemoul el Akbar lies an interesting region. First comes the Dahar, dissected country from which the watercourses drain toward the sands and locally toward the Shott Djerid. On the eastern flank rise the remarkable hills, of Triassic to Cretaceous rocks, that are the key to the fortress defences of eastern Tunisia between the frontier, Foum Tatahouine and Matmata, the Mareth line. From the topographical point of view they are the last traces of the Tripolitanian Jebel, which on the Italian side is defended from the hills of Nalut.[1]

On the seaward side of the hills, and dominated by them, is the coastal plain (the Djeffara). Here lies the only route for the coastal road that leads eastward to Tripoli, westward to Sfax, Tunis, Bizerte, and into Algeria: it is dominated by the defences of both sides. The plain is narrow between Medenine and Gabès, but broadens again between Sfax and Sousse and eastward between Medenine and Zuara, tapering off till the Jebel reaches the sea at Homs.

Considerable areas of the coastal plain have been colonized and intensively cultivated by the French in Tunisia, especially around Sousse and Sfax, where there are olive plantations of great extent, and by the Italians. The Italians have also established colonies in the coastal plain on the west side of the Gulf of Sirte and in the adjacent higher ground of the Jebel. The Jebel is naturally sparsely vegetated on the limestone uplands; olives grow in the valleys and native cultivation was concentrated in them, the higher ground being given up to grazing. Italian colonization and irrigation has made considerable headway.[2]

Communications.—For purposes of this lecture we may consider communications to be of three classes: (1) Country passable by mechanical transport, irrespective of defined tracks; (2) the tracks and routes of the country, based on camel transport and used since very early times; (3) "autopiste,"

[1] G. L. Steer gives an interesting account of these defences in 'A date in the desert,' London, 1939.

[2] Compare a report of the early years such as "La Missione Franchetti in Tripolitania (Il Gebel)" (Società Italiana per lo Studio della Libia), 1914, with accounts given in the literature published by the Italians in the years immediately preceding the outbreak of the present war, also E. J. Russell, *Geogr. J.* 94 (1939) 272; and with a description of the mass migration of colonists from Italy, *e.g.* M. Moore, 'Fourth shore,' London, 1940.

i.e. routes artificially improved for the use of mechanical transport, for the most part based on native tracks, and motor roads specially designed as such, metalled and surfaced throughout their length or according to local needs.

So far as the first class is concerned it is probably true to say that modern mechanical transport, skilfully driven and well maintained, can operate fairly freely over most of Libya, irrespective of roads, with exceptions which would include the following: the sand-burdened areas, where mechanized movement is in fact often possible but liable to be slow and fraught with difficulty; the broken highlands of the south-west and to some extent in the volcanic uplands of the centre, though even in the highlands the wadis are negotiable; ravined, boulder-strewn, and cut-up country, salt-pans, wet clay, sand and salt-marsh, and the like.

The scale on which cross-country travelling is possible in Libya could not be better illustrated than by the astonishing patrols of the Long-range Desert Group, led by officers well known in this Society, and it is to be expected that one day a full account of their accomplishments will be forthcoming. The best account so far available in this country seems to be that of *The Times* of 14 February 1941.[1] In the winter campaign of 1940–41 their main sphere of operations was in the vast emptiness that lies between the highlands of Cyrenaica and Kufra, and within it they came and went very much as they pleased. In the far south contact was made with the Free French forces operating from the Chad Territories and Tibesti. Combined operations led to the fall of the Italian garrison in Kufra. 'Uweinat, so long an outpost, the scene of one of the actions of the Long-range Desert Group, passes out of the picture.

Perhaps the most astonishing feat was the raid on Murzuch, Traghen, and their neighbourhood. A glance at the map will show the distances involved from any base—and at that time Kufra was in enemy hands. Two further points should be borne in mind about this raid. It produced the anomaly of Frenchmen immobilized on one side of the frontier—since most of French Africa adhered to the Vichy government—while their warring compatriots from Equatorial Africa raided northward with the British on the other side of the frontier. The raid brought Allied troops and vehicles, albeit in modest numbers, to the "autopista" road system that leads to the heart of Tripolitania.

The second-class tracks and routes of the country do not call for much comment here. A glance at detailed maps of the western half of Libya shows the country to be criss-crossed with such tracks, and with obvious exceptions it is a reasonable supposition that light mechanical transport can cover most surfaces that can be traversed by loaded camels. From the Gulf of Sirte to Tibesti, from Brach and Murzuch to Tazerbo, Kufra, and beyond the Italians have found, and mapped, many such routes suitable without improvement to their military vehicles. In the western Fezzan routes of this class seem to be fewer, but at least three lead from the Ubari–Gat motor road westward to the frontier.

In the region of the Tunisian frontier there is an interesting contrast

[1] See *Geogr. J.* 97 (1941) 396. While this lecture was in proof a good account, with map, has appeared in 'Destruction of an army,' H.M. Stationery Office, December 1941.

between French and Italian road policy imposed by considerations of defence and the nature of the ground. On the Italian side, where the ground is high, a motor road runs near the edge of the Hamada el Hamra, at the heads of the valleys that drain to the sand dunes of the Zemoul el Akbar, from Gadames to Nalut, thence eastward along the Jebel to the main road system radiating from Tripoli. On the French side Medenine is the most easterly main road centre, whence a southerly branch goes no farther than Foum Tatahouine and an easterly road goes through Ben Gardane to the frontier. From Foum Tatahouine there radiate southward and eastward tracks suitable for motor vehicles, all of them joining at widely separated points a frontier patrol track which runs from Ben Gardane southward along the length of the eastern frontier of Tunisia, skirting the sand-dune area, crossing the wadis that descend from the western face of the Hamada el Hamra, and so passing west of Gadames to the Hamada of Tinghert and the Saharan communications.

The third group of communications may be taken to include all routes primarily intended or maintained for motor traffic, and upon them Italy has spent lavishly of her engineering skill, financial, material, and labour resources. These excellent roads have proved her undoing both in East and North Africa, since they have provided unrivalled means of rapid advance for Imperial and allied troops. In Libya we may recognize two systems: the Cyrenaican which serves the coast and highlands, and the Tripolitanian which serves not only coast and highlands but the western frontier and the Fezzan. The two systems are joined by the road between sea and desert along the coast of the Gulf of Sirte, thus providing in effect a coastal road: the Littoranea, from the French to the Egyptian frontier. From Zuara through Tripoli to Homs there is also the railway, with a branch southward as far as Garian. Coastal Libya lacks nothing in west–east communications.

It must be borne in mind that very extensive territories lie to the south of coastal Tripolitania over which the Italians have driven their roads, and the southern system may be regarded as an adjunct of the Tripolitanian network rendered necessary in large measure by the reoccupation of the Fezzan in 1930. They are, then, roads to ensure internal security and development, but their plan is doubly interesting at the present time. The following brief account of them is based on information published up to the time of Italy's entry into the war.

One route leaves the coast road about midway between Sirte and Misurata and runs south to Hun, whence a branch runs eastward to Zella. The main road continues southward from Hun through Socna and Sebha to Murzuch, and a further section branches a little south of Sebha, runs westward through Ubari and then south along the wadi Tanezzuft to Gat. The Fezzan is thus traversed by roads which pass through the oases and wadis which are the essential locations of population. Sources of water have been explored and improved, and the Italian administration would seem to have little cause for anxiety on this score.[1]

From the network of roads that has been built in the Tripolitanian coastal

[1] In addition to 'Il Sahara Italiano,' see a review of recent successful deep borings for water "Verso la soluzione del problema delle acque profonde in Libia"; "Rivista Libia," Anno II, Luglio, 1938 (No. 7).

plain and Jebel, the detail of which we need not consider here, two important routes run south. The eastern passes from Garian (railhead) through Mizda to Brach, whence there is a west–east road to the head of the wadi esc Sciati and to join the Fezzan road between Socna and Sebha. The western road from the coast, as already mentioned, runs close to the Tunisian frontier through Nalut to Gadames.

Although these roads were ordained by internal needs, it is nevertheless a fact that they lead to the western frontier and that they provide alternative north–south routes, and in view of the elaborate defences in the north, facing Tunisia, it seems reasonable to assume that the roads were laid down as part of a strategic policy as well as for internal security.

The war having taken an unexpected turn, Italy finds her interior communications in Libya secured from the west but threatened from the east, from which side more than one motor road, as well as numerous passable tracks, lead by the back door, so to speak, to the very centre of Tripolitania. The Italian Command may question, therefore, whether their roads leading south and east are really an asset in the present circumstances unless new German and Italian mechanized and motorized units can roll along some of them, and above all along the road that leads to Bengasi.

So our minds turn to the sea. It is easy to appreciate the benefits that would accrue to Germany and Italy if Bizerte or French African ports with adequate unloading equipment were fully at their disposal. Roads lead thence to Tripolitania, with some rail facilities there, as in Tunisia. The value of naval and air bases on both sides of the Mediterranean is obvious enough. These are but elementary considerations of obvious military and political problems in western Libya: they are only part of the problem of the French Empire in Africa. Farther west is the enigma of the Atlantic coast, Casablanca perhaps analagous to Sfax, Tunis, Bizerte or an Algerian port, Dakar possibly more desirable in German eyes than Suez.

Sources of water.—Incidental references have been made to water supply, and it has been suggested that they might be amplified. The following notes describe only the generalities of the subject, with some examples. A considerable amount of detailed information is available.

Sources may be described as surface and sub-surface, and deep. The former have long been exploited by the native population, the latter have usually been beyond the capacity of native enterprise but have been tapped by the Italians, sometimes with spectacular results.

Native sources of water.—The surface and sub-surface sources are such as may be found throughout arid Africa and adjacent parts of Asia, their exploitation by primitive means long since mastered by native Berber peoples and Arabs alike. It is unnecessary to review them in detail here, and a description of a very similar area was published in the *Journal* a few years ago (*Geogr. J.* 85 (1935) 412). It will be sufficient to give a few examples: sources in wadi beds and saturated sands; flowing water from springs; and water-tables either exposed or reached by wells. It is probably true to say that the native supplies in the Fezzan are dominantly of these categories. In the high-

lands of the south-west the run-off, carried into the valleys, sinks into the alluvial sands, clays, and pebble beds, whence it is obtained by digging pits and deeper wells, *e.g.* the wadi Tanezzuft. The best-sited wells are those where the alluvial beds are thickest, those over shallower parts of the valley's cross-section may run dry as the season advances. Within the hills the usual rock-pools and the like may be expected.

The largest valleys of the Fezzan, as already described, conduct sub-surface water for long distances through arid country, and this water is obtainable at favourable spots, *e.g.* the wadis Irauen and esc Sciati. Where these valleys fade out in the plains, sands and finer alluvial deposits hold the water and make it accessible near the surface, and it may be exposed in pools. Where these conditions coincide with the run-off from ridges into channels which are bordered by wind-blown sands the prospects of water being available in large quantities are enhanced, *e.g.* the wadi Bergiug and El Hofra region. Thus the numerous oases of the eastern and central Fezzan can support a considerable native population with flocks, palms, and some agriculture. Water is also available in the heavily sand-burdened areas; where permanently exposed such water may become saline or support salt marsh, *e.g.* Murzuch area, Edeien Ubari.

The widespread and varied sandstones which are so prominent in the geology of highland and lowland alike in the Fezzan and in southern Libya are not only capable of containing much water but of transmitting it at some depth over great distances. Inequalities of surface may allow springs to flow on the surface from these water-tables, either as running water in broken country or as permanent pools in the desert plains. Adjacent uplands of rocks such as basalts may add to the available water near the margins or in the surrounding country. Sources in the eastern Fezzan and central Libya are probably to be attributed to these origins, and, as already stated, the Italians have found them to be of excellent quantity and good quality, *e.g.* Bu Hascischia, Uau el Chebir, Kufra.

North of the Fezzan the great expanses of limestone present new conditions, since water is likely to sink deeply through them and possibly to be canalized along fissures. Again large quantities may be preserved, but depth may be considerable. Where faults and flexures are present, or where, as in Tripolitania and Cyrenaica, the limestones are broken by scarps and deep valleys, prolific springs may occur, especially where clays and shales are interbedded with or underlie the limestones. The native sources of these parts therefore differ considerably from those of the south. In these northern territories moreover successive ruling nations in antiquity have superimposed on yet more ancient native methods a high degree of engineering skill in finding, conducting, and storing water, building of retaining walls in valleys, well-digging and cutting of vast numbers of subterranean rock cisterns, especially in Cyrenaica.[1] Arab invasion, infiltration, and eventual population here led to neglect and decay of some of these works.

The coastal plains, where wide, both in Tripolitania and Cyrenaica, consist often of old beach deposits, sands, gravels, clays, and alluvial material. Moreover the rainfall on the coast is considerable and there is an appreciable run-off

[1] See especially H. W. Ahlmann, "La Libye septentrionale," *Geogr. Annaler*, 1928.

from the adjacent highlands. Water has therefore been fairly readily available along these coasts in favourable localities.

The shores of the Gulf of Sirte seem in theory to fulfil the conditions just outlined and yet to fall short in practice. The reasons are to be found in a number of circumstances, not all of which are yet fully known. In the first place transmitted water may find its way toward the surface in these coastal lowlands, and salt pans and marsh result. The Miocene and more recent beds which overlie them include clays and marls which hold the water in pockets and prevent even distribution. Such pools and small supplies may be saline, muddy, or liable to dry up. Shallow wells sunk in this area may be ephemeral or saline. Here and there good springs have been found and small centres have sprung up round them. It is common also in areas like this for springs to reach the surface near the shore either on the beach (or below sea-level) or inland behind sand dunes. It will be realized then that local conditions, as well as a lesser rainfall than in the coastal highlands, minimize the prospects of obtaining good water either near the surface or at some depth.

Deep sources of water.—There are three types of source available to European exploitation with good well-digging and boring apparatus. First, in the highlands wells may be sunk deep in the thick water-bearing alluvial deposits of the wadis, or in the adjacent sandstones.[1] Secondly, the water-table of the great desert plains which supplies the oases can be tapped with advantage by deep wells and borings, artesian water thus being made available. This may also be done in the coastal highlands, but in Cyrenaica the geological conditions have so far presented special difficulties to effective boring. In these coastal areas good results have been obtained by following the methods of antiquity, *e.g.* the water supply of Bengasi, which is brought from distant springs.

Thirdly, the Italians have in recent years undertaken an ambitious programme of deep boring along the coast of Tripolitania, and highly productive water-bearing beds have been tapped. The very existence of their agricultural colonies depends on these deep supplies, several of them reached by borings 1000–1500 feet deep. The water is generally of good quality, and very remarkable yields are reported.[2] It is possible that these schemes are "drawing on capital" in that the water so utilized may not be replaced at depth as fast as it is removed from the wells, in some of which the water reaches the surface with considerable force. Critics of the agricultural development suggest that yields may diminish and that the water may suffer from increasing salinity, but at present, so far as I know, there is no unmistakable sign of any such failure either of quality or quantity.

DISCUSSION

Before the paper the PRESIDENT (Sir GEORGE CLERK) said: The paper this afternoon will be read by Dr. Kenneth Sandford, who needs no introduction to this Society. He is a member of our Council who is distinguished for his geo-

[1] A preliminary survey of water resources, presumably with a view to such improvement, had been made by the Italians in the years before the war: see A. Desio, "Acque superficiale e sotterranee" in *Il Sahara Italiano* (part I, Fezzan e oasi di Dat, p. 121).

[2] See A. Desio, "Verso la soluzione del problema delle acque profonde in Libia"; "Rivista Libia," Anno II, Luglio, 1938 (No. 7).

graphical work both in the Arctic and in the deserts of Egypt and Libya. Dr. Sandford is associated with those other Fellows of the Society who have done such good service as leaders of the Long-range Desert Group and is particularly fitted by his knowledge of geology to inform us upon the strategical importance of the desert land forms in Western Libya. We could not have a subject more appropriate to the time. I am sure we shall enjoy immensely listening to one who can speak with authority on a part of the world which is having such great influence on the war in its present stages.

Dr. Sandford then read the paper printed above.

The PRESIDENT: We have, I am sure you will agree, listened to an extraordinarily interesting lecture, especially so at this particular time. We owe a great debt of gratitude to the lecturer for the clear account he has given us and for showing us the country in which our men are fighting now.

Admiral Sir WILLIAM GOODENOUGH: I should have hesitated to speak but for the use of the word "strategical" by our President and the reference to military matters and communications which the lecturer made in an extraordinarily clear lecture. Dr. Sandford spoke of the domination of certain roads by forts and of the difference between camel and mechanized transport, but one frontier which he had not time to mention is the northern, the sea. As long as it was camel transport it did not matter much, but once it becomes mechanized, the motive spirit being petrol, it is vital we should hold that northern frontier of the sea.

I should like to refer to a matter more personal to this Society: the distinction which has been earned by one of the Society's Gold Medallists, Colonel Bagnold. What he has done in the desert is no longer one of the vital secrets everybody talks about. He recently wrote me a letter in which he said he had never anticipated that a peace-time amusement would have become a war-time usefulness, or necessity.

The PRESIDENT: I am sure you all join me in expressing our gratitude to Dr. Sandford for what he has told us.

THE NUER

THE NUER: a description of the modes of livelihood and political institutions of a Nilotic people. By E. E. EVANS-PRITCHARD. *Oxford: Clarendon Press*, 1940. 9×5½ *inches;* xii+272 *pages; illustrations and sketch-maps*. 17*s* 6*d*

THE author here describes, in certain of their aspects, that tall, slender, black, dolichocephalic, dour, and very conceited people, the Nuer of the Egyptian Sudan. The Nuer are very similar to the Dinka, both physically and in language and customs, while the Shilluk are somewhat less akin. Their physical type stretches right across the Sudan to the Chad region, where the Bana and others bear a very distinct resemblance to this Nilotic folk.

The present volume treats of their modes of livelihood and political institutions, reserving their domestic life for a second volume. There is no mention of what appear to many the most interesting features of anthropological research, namely, religion and magic. The investigation, which lasted about a year in all, was carried out under very serious difficulties, the chief being the passive resistance of the people shown to any seeker for information. Finally the author obtained most of his facts by taking up his residence in the middle of villages and witnessing, and taking part in, the actual life of the people. The next

greatest difficulty perhaps was the want of a good interpreter, since the assimilation of a native tongue well enough to delve deeply into beliefs and a complicated social organization is a question of years, not months, even for persons specially gifted linguistically.

The book is mainly devoted to a description of Nuer economy and social structure and, in between, to their ideas of space and time, which are shown to follow the relations between the two former. The economy depends on the equilibrium between the pastoral life, agriculture, and fishing. Existence would become almost impossible to maintain to any satisfactory degree if any one of these sources failed.

For the greater part of the year the Nuer are pastoralists; their life practically revolves round their cattle, chiefly cows, with whom they pass an almost perfect symbiotic existence. It would be hard to say whether they, or the cows, are the parasites. The cow is the chief object of conversation and their pride; it supplies the milk, on which they, and especially their children, chiefly subsist; the dung for their fires; and the meat for their festivals. The health of the herds determines the movements of the village, and their possession regulates marriage in that a son cannot acquire a wife until a certain number of cattle is available for him to set up housekeeping. The pedigree of a cow is accurately known, with full particulars of each ancestor for generations back, and the pugnacious Nuer is more sensitive on the subject of his cattle than on any other matter.

The endless marshes and wide savannahs afford good pasturage, while agriculture, principally the growth of millet, is practised on the higher grounds. The people are forced to have a mixed economy, since neither cattle nor millet provides sufficient nourishment—specially after the arrival of rinderpest some fifty years ago, which has caused considerable changes such as a reduction in the number of cows, and the coming of Government, which put a stop to their raiding the Dinka to replace the cows.

The only other source of supply comes from the fishing, specially in the dry season, when large numbers of fish are caught in the lakes and lagoons as the water recedes. Fowls are not kept, and it is considered "shameful" for any but the young to eat ostriches, guinea-fowl, and ducks. The author does not mention tabus in this connection, but it would appear somewhat strange if these were not concerned.

There is a considerable sharing out of food owing to the fact that at any time any family may run short of supplies; this is especially the case in the near kindred groups. The country is poor and there is practically no stone, wood, or iron, while trade is almost non-existent. The effect on the character of the inhabitants is to make them hardy, brave, proud, and independent. They are remarkable for their self-sufficiency, simplicity of culture, and the fixation of almost all their interest on their herds.

There is a very strong national feeling among the Nuer. They are marked off from all others by their cultural identity, especially their language, and, physically, by the absence of lower incisors in the case of men and the six deep cuts across their foreheads. Their aloofness is nourished by the strong opposition felt against all non-Nuer, who are considered decidedly inferior creatures. In many respects this people might be considered the Spartans of Africa.

Within the nation are many tribes, inclusion in which does not depend solely on kinship, as, though there is generally a dominant clan within a tribe, the same clan may exist to a smaller extent in other tribes also. A tribe is united by its common name, sentiment, territory, age-classes and, most of all, by its obligation to unite in defence or attack and to settle feuds by arbitration.

The tribe is divided into primary, secondary, and tertiary segments, or sections, the last of which comprises various villages, themselves composed of kinship and domestic groups. A tribal segment is crystallized round a "lineage" of the dominant clan of the tribe and the smaller the segment the closer the genealogical relationship between members of the clan segment. Each segment is itself segmented and there is opposition between its parts. The members of any segment unite for war against adjacent segments of the same order and also with these adjacent segments against larger sections. The tendency towards segmentation is a fundamental principle of their social structure. The political system forms an expanding series of opposed segments, from the relations within the smallest tribal section to intertribal and foreign communities.

A considerable part of the book is devoted to the lineage system, which is described in detail. A clan is defined as " the largest group of agnates who trace their descent from a common ancestor and between whom marriage is forbidden. . . . It is not merely an undifferentiated group of persons who recognize their common agnatic kinship, as are some African clans, but it is a highly segmented genealogical structure. We refer to these genealogical segments of a clan as its lineages. . . . A clan is a system of lineages and a lineage is a genealogical segment of a clan." Village communities are deemed to correspond in certain respects to minimal lineages, tertiary tribal sections to minor lineages, secondary tribal sections to major lineages, primary tribal sections to maximal lineages and the tribe to the clan. The author lays great stress on the fact that the opposition between the various sections affords one of the main causes for the solidarity of any one section: a process which operates from the smallest to the greatest unit.

Dr. Evans-Pritchard's method of exhaustive inquiry into the somewhat intricate social organization, especially from the point of view of the distance between the various political layers, puts a powerful weapon into the hands of future investigators, both in the case of a comparatively simple structure like that of the Nuer and of more advanced communities.

As is natural, considering their sensitiveness and proneness to take offence, fighting may be said to be one of their main preoccupations from childhood. The fear of incurring a blood feud is the most important sanction and the main guarantee of an individual's life and property. There is no way of settling a dispute except by fighting it out, which is only stopped by serious injury, or by bystanders pulling apart the two disputants, or by mediation as mentioned below. Men of the same village or camp fight with clubs, but when there is a dispute between different villages spears are used and every adult male is drawn into the fray. The taking of vengeance is one of the chief duties of the Nuer, but homicide can be settled without developing into a blood feud by the payment of cattle: fairly easily in the same clan or village, where the parties are close kin or neighbours, but the more distant the incident is in place or kinship the greater the difficulty, until the intertribal stage is reached, when a state of war comes into operation.

Disputes are usually settled by the mediation of leopard-skin chiefs, so called because of their right to wear such a skin over their shoulders, though they possess little real authority. The same chiefs are made use of to adjust differences in the few cases, such as adultery, theft, and compensation for injury, in which there is a certain agreement as to procedure and result; otherwise there seems to be an absence of all general law or custom.

In addition there are certain prophets and owners of fetishes who possess some prestige, but there is no ruling class and no council of clan elders. Every man is as good as his neighbour and will take orders from none; the utmost any

one can do is to ask as a favour from his kin. There is no organized political life. The Nuer recognizes no superior. It is a case of democracy run to seed, quite different from that of the western negro, whose intelligence, friendliness, and sense of humour make him so attractive to the European.

Dr. Evans-Pritchard tells how when he was sick at the end of his stay and being removed by steamer, "I asked the people to carry my tent and belongings to the river's edge. They refused, and my servant, a Nuer youth, and I had to do it ourselves. When I asked him why the people were churlish, he replied: 'You told them to carry your belongings to the river. That is why they refused. If you had asked them, saying, "My mother's sons, assist me," they would not have refused.' "

Such a state however has its good sides. As all Nuer are equals, if any one has a surplus of anything he must share it with his neighbours; so no surplus lasts long. They are not above begging persistently for any article of which a man has several examples, such as hoes or spears, and, if by any chance someone manages to secure any tobacco, he must keep it well hidden, or it goes the same way.

The last chapter deals with the age-set, more usually known as the age-class system. Boys are usually initiated when from fourteen to sixteen years old by a very severe operation, called the Gar, when their brows are cut to the bone by six long slashes. On an average there are about six sets in a generation from grandfather to son, and generally there is an interval of about ten years between the sets. At his initiation the boy becomes a man or warrior and may marry and start a household.

The age-classes are segregated at sacrificial functions. A man may not marry, or have sexual relations with, the daughter of an age-mate. All those of one class associate in work, play, or war on terms of equality and are expected to share their possessions: not however extending to their wives, as in some Nigerian tribes. Age-mates are "brothers"; members of the senior class above them are their "fathers," and those of a junior class their "sons."

The book contains not only the field-work but also a detailed investigation into the rather involved theory, which explains and accounts for the facts actually found to exist in the social structure of the Nuer polity. It is brilliantly conceived and executed and in most respects could only be adequately criticized by some future enquirer able to spend a much longer time on the spot than was possible for the author. An occasional feeling that theory is overstrained and goes beyond the facts is probably unjustified, though perhaps the presence of the large proportion of Dinka, who have become incorporated in the Nuer state, may vitiate some of the conclusions drawn.

The work sets a very high standard for future investigators, and will be a necessity for all those interested in human society, negro or otherwise.

P. Amaury Talbot

ROUTES TO RUSSIA THROUGH IRAN

The Red Sea, including the Suez Canal, and the Persian Gulf have much in common with regard to current strategic issues. Both are arms of the Indian Ocean and both penetrate towards the middle eastern theatres of war, the one to the Mediterranean, the other towards the Caucasian region of Soviet Russia which, with its rich oilfields, must constitute one of the vital objectives of the German invasion of that country.

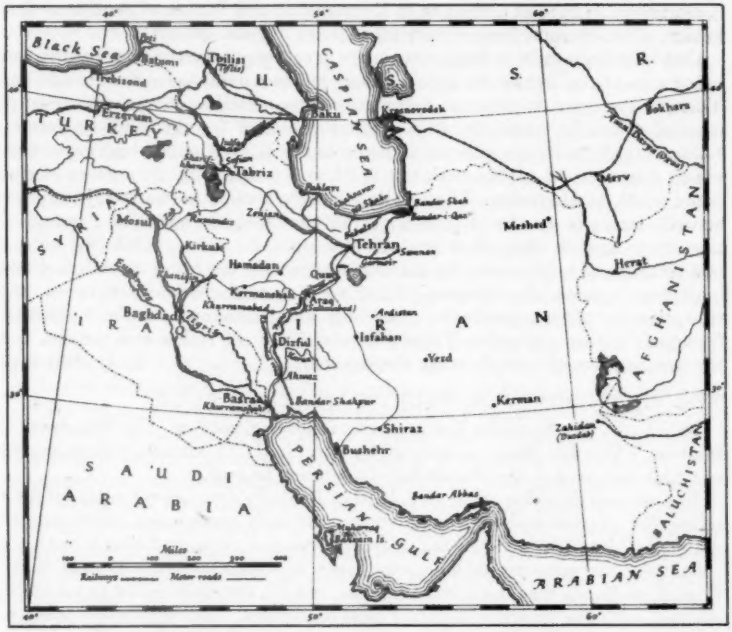
The Persian Gulf however is separated from Russian territory by the lofty, rugged, mountain-girt plateau of Iran. Western Iran is an enormous isthmus: from the head of the Gulf the shortest distance across this isthmus is that following a line through Tehran to the southern shore of the Caspian Sea, about 400 miles, while that from the Gulf to the Russian frontier beyond Tabriz is more than 600 miles. Yet, given adequate communications, supplies from parts of the Empire, particularly India, could reach Russia more expeditiously through Iran than by any other route left open. Even this is no easy matter, for transport facilities in the latter country are still at a rudimentary stage of development. Less than twenty years ago, it was the only large country in the world without a railway save for the Indian line reaching Zāhidān (Duzdāb) a few miles inside the Baluchistan frontier and that from Julfa to Tabriz in the north-west, constructed by the Russians during their occupation of that region (1909–1918). In recent years however, as the result of costly engineering, the two seaboards have been connected by a good motor road and a railway: the trans-Iranian line, opened in 1938. Both routes moreover pass through Tehran and have already exercised a marked effect upon the economic development of the country.

The problem of transport across Iran is at least a threefold one. First there is the improvement of ports at the head of the Persian Gulf; secondly the organization of overland transport; and thirdly arrangements must be made either to avoid transhipment at the Soviet frontier, or if that is impossible, to conduct it as smoothly as possible. In the absence of through-railways from the Gulf to Russian territory, it is probable that transhipment at the Iranian ports on the Caspian or the use of a coast road into Transcaucasia are most likely to be chosen in solving this phase of the problem.

Conditions at the Gulf ports have greatly improved in recent years and there already exists a considerable tonnage of Soviet shipping serving the Caspian ports which could doubtless be supplemented by river craft from the lower Volga. Of the 7,054,500 tons of shipping entering the Persian Gulf ports of Iran during the year 1937–38, more than 5,000,000 tons were British, while of the 497,098 tons entering the Caspian ports of that country in the same period, more than 480,000 tons carried the Soviet flag.

Of the Gulf ports, Bandar Abbas, the distributing centre for the eastern interior, and Būshehr with its motor-road connection with Shiraz and the capital have declined in favour of newer ports at the head of the Gulf. Thus Khurramshahr (formerly Muhammerah) on the Shatt-al-Arab is now the chief port of Iran and functions as a major distributing centre for the north and all the western interior. Seagoing vessels however cannot berth at the quay and must discharge by means of barges. Transport by river craft is continued to Ahwaz which lies inland some 80 miles up the Karun River and through which pass both the trans-Iranian railway and the Khurramabad motor road from the Gulf. In the late summer and autumn river traffic from Khurramshahr may be

much delayed by low water so that transport by road is substituted. Further east, near the mouth of the Khor Mūsa estuary, is the port of Bandar Shahpur, built a few years ago to serve as the terminus of the new railway. Already a large amount of traffic is handled there, but improvements in landing and unloading facilities are needed, though work in this connection is proceeding. Ship-repairing on a limited scale can be undertaken nearby at Khor Mūsa. Among the ports at the head of the Gulf, the importance of Basra, the main port of 'Iraq, must not be overlooked. In the Gulf itself, situated about half-way between the entrance and the head, are the Bahrain Islands, long under British protection



Including Muharraq, with its aerodrome, they have their own oil supplies and provide a useful base for the protection of shipping.

On the Caspian shore there are several small poorly equipped ports, most of which are nevertheless reached by roads from Tehran and other interior centres. Bandar Shah, the northern terminus of the trans-Iranian railway, lies close to the Soviet Turkistan border and is 300 miles by sea from Baku. Nô Shahr, developed a few years ago, is the nearest port to the capital. There are also Pahlavi, the chief of the older ports, which is 200 miles from Baku, Shahsavar, Bābulsar (Mashad-i-Sar), and Bandar-i-Gaz.

The only route into Russia of likely importance other than those *via* the Caspian is that from Tabriz. This centre is connected by a 400-mile motor road with the capital, and by railway to Julfa inside the Soviet frontier, the line continuing to Tiflis. Recently Erzerum, already linked with the Russian line though with a break of gauge, has been connected with the rest of the Turkish railway system. By this railway, together with a road from Trebizond *via*

Erzerum suitable for lorry traffic, Tabriz is brought more closely into touch with western communications than any other Iranian city.

Though the conveyance of supplies in quantity to Iran must be primarily by sea, a few landward approaches to the country may be of use from 'Iraq on the one side and from India on the other. These are shown on the map. With an abundance of road metal in the country and a plentiful supply of motor fuel from the refineries of the south, it is evident that the state programme for the improvement of communications in Iran will continue to favour road development. Over western Iran in particular modern roads are steadily making up for the absence of railways, the distribution of oil having been facilitated by the construction in 1935 of a pipeline to Kermanshah and the use of enormous tank lorries, of which some have a carrying capacity of 4000 gallons.

One important railway project however is envisaged for the near future, this being a line from Tehran to Tabriz which will eventually unite the Iranian and Turkish systems. At present however communications across the country depend primarily upon the new arteries provided by the Gulf-to-Caspian railway (1938) and the motor road known as the Khurramabad highway (1928) which connects the capital with the Gulf, and passes through a place of that name south of Hamadan. These follow closely similar routes to Tehran and actually intersect at Ahwaz, Dizful, 'Araq (Sultanabad), and Qum, though it remains to be seen what effect one will have upon the other. While the railway is a triumph of engineering its use is hampered by the heavy operational and maintenance costs, the slowness of traffic owing to the numerous curves, and exceptionally severe gradients, the long total distances involved (Bandar Shahpur–Tehran 520 miles, Tehran–Bandar Shah 288 miles) and the fact that the line consists of a single track throughout. K. C. EDWARDS

THE SHEPHERD OF BANBURY'S WEATHER RULES

Mr. L. C. W. Bonacina has sent the following note on The Shepherd of Banbury's Weather Rules, annotated by Mr. G. H. T. Kimble, a short review of which appeared in the November–December *Journal*.

In assessing the value of the Shepherd of Banbury's twenty-six rules for foretelling the weather it should be noted that the early anonymous editor omitted many useful details found in the original version of 1670, and that though the rules were the outcome of long experience in a district fairly typical of the English midlands they must be studied as, indeed, the early editor to his credit insisted, with due regard to different local conditions. The Shepherd's observations bear, as Mr. Kimble points out, the mark of authenticity, and show knowledge both of sequence and persistence of weather; but the rules are of very unequal value.

Among the fairly good rules is the first which formulates the old adage about red sky in the morning (mentioned in Virgil, Pliny, and Theophrastus as well as in St. Matthew's Gospel): "If the Sun rise red and fiery, Wind and Rain." In this rendering the whole value of the prognostic depends on the restriction of the category of mere redness by the qualification "fiery." The eastern sky is nearly always more or less red at sunrise; but tangled webs of cirrus and high stratus cloud moving from the west and reflecting with ruddy glare the rays of the rising sun whilst passing overhead are significant as being commonly in the forefront of rapidly approaching rain: whereas similar flamboyant sky in the evening would signify that the bad weather was probably receding. Some of the latter rules recognizing signs of thunder and predicting the number of hours which rain in different conditions will last are also good; but special mention must be made of part of XVII in the following terms: "The wind usually turns

from North to South with a quiet Wind without Rain, but returns to the North with a strong Wind and Rain." This is, perhaps, the best example of accurate observation in the whole set of rules as it reflects the sequence of backing and veering winds when a depression with its centre to the north moves across the country—the more creditably as the Shepherd himself had no knowledge of fronts and depressions.

The doubtful rules are either misleadingly simple like some of the early ones which state that small clouds increasing mean rain and large clouds decreasing fair weather, or else too unwieldly to be verifiable with any certainty, such as two to the effect that after a number of complicated turns the wind will finally settle in the north-east or south-west for a long spell as the case may be. The attractive rule (IV): "Clouds large like Rocks, Great Showers" might seem obviously true, but the breadth of the category makes it doubtful. Not all the rock-like cumulus formations which picturesquely diversify our summer skies develop showers, though an experienced observer can generally tell whether they are likely to do so. This rule is omitted in Joseph Taylor's 'Complete weather guide' (1814) which includes the Shepherd of Banbury's Weather Rules, and the twenty-five are quoted in the Meteorological Glossary, 1st ed., 1918.

Thoroughly bad rules are the last three which predict summer drought on the strength of dry weather in late February or early March, hard weather in January and February after late October or early November warmth, and conversely mild weather in the early year after snow and frost in the autumn. These rules were statistically examined some years ago and the resulting correlation coefficients found to be devoid of significance. (Meteorological Glossary, 1st edn., 1918). Again, the very curious rule which declares that in the course of eight years there is as much south-west as north-east wind simply does not fit the climate of England, though Mr. Kimble makes a brave apology for it on evidence for more east wind in the Shepherd's time than we nowadays experience. Lastly, three rules (IX, X, and XI) which base prognostics on the occurrence of general morning mist at certain phases of the moon are vitiated by the widespread countryside fallacy of the dependence of the weather on the changes of the moon, and their obscurity is increased by the first editor's suppression of the Shepherd's explanation in the 1670 edition that by "general mist" is meant a mist overspreading hills and dales alike. Of this omission the new editor seems unaware since in an attempt to interpret one of these prognostics for bad weather he writes of "mist" as though it might relate to sheets of high cloud giving a misty appearance to the moon with halos as so often in advance of bad weather.

Whatever the shortcomings of these Rules it must be conceded that they display a good deal of acumen and that their authof made quite a good attempt at single-observer forecasting, the possibilities of which to-day have still to be fully explored. If progress in this difficult subject has been slow it is because only a few of the common types of cloud and appearances of the sky are sufficiently definite and unambiguous in their significance to be readily classed as prognostics, and these few were discovered long ago. But in the complex detail which the changing sky picture presents and in the response of the landscape to the varying quality of the light there probably reside many weather signs only awaiting recognition through close observation. Hence a single observer, with or without the help of a barometer, should often be able to supplement or rectify the official forecast by synoptic chart as bearing on his own locality, provided he has a fund of local experience to draw upon and a sound knowledge of meteorological principles.

LATITUDE AND AZIMUTH BY CLOSE CIRCUMPOLAR STARS

We have received from Major W. E. Browne, R.E., a paper on a Graphical method of determining latitude, altitude, or azimuth by close circumpolar stars, by which with the aid of two diagrams, one on tracing-paper to be superimposed upon the other, it is possible to derive with an accuracy of about 1½ minutes of arc, the latitude and azimuth from an observed altitude. Four close circumpolar stars are laid down to a large scale on an equidistant polar projection, and a "planisphere" or graticule of curves for altitude and azimuth, calculated for a given latitude, is drawn on tracing-paper and rotated over the star chart until an arrow marked S.T. points to the Sidereal Time on the star chart, or the date inscribed round the circle of the planisphere points to local mean time. The azimuth and altitude of any of the plotted circumpolar stars is then read directly on the planisphere. To obtain the stated accuracy it is sufficient to construct planispheres for each 5 degrees of latitude.

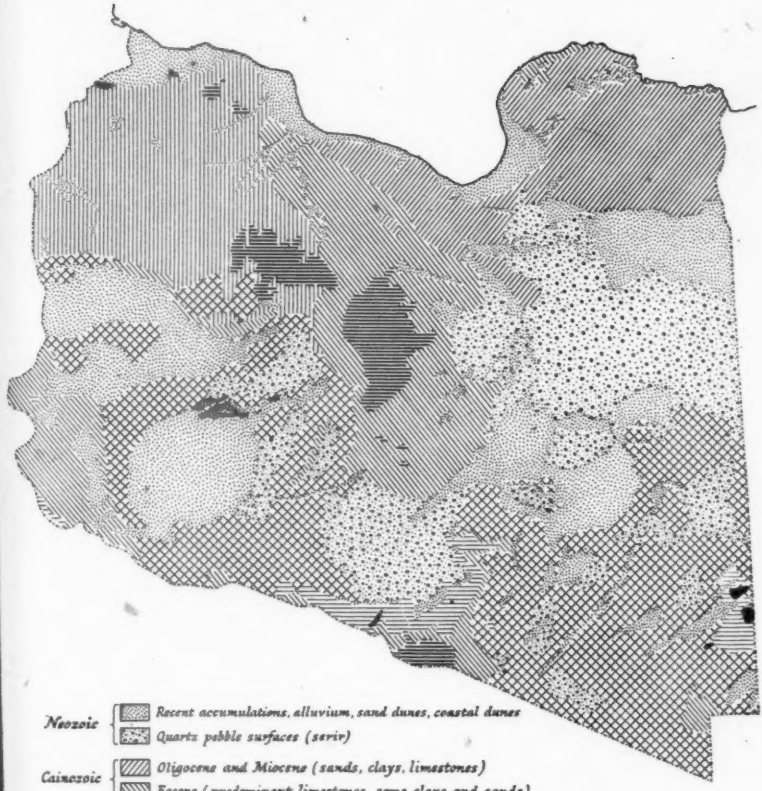
It is not possible in present circumstances to reproduce these two charts on a useful scale, but the paper and specimen charts will be placed in the Map Room, where they may be studied by those interested.

THE MYSTERY OF THE DISPOSAL OF THE REMAINS OF JOHN BAXTER

In February 1841 Edward John Eyre, with John Baxter and three aborigines, set out from Fowler's Bay in South Australia for Albany in Western Australia. On the night of April 29, while Eyre was watching the horses a quarter of a mile from camp, Baxter was shot by two of the natives, who plundered the camp and disappeared. The ground was solid rock, and Eyre could do no more than leave the body of his companion wrapped in his blanket.

In March 1882 the Postmaster at Eyre Sand Patch, on the old Telegraph Route, sent to the Colonial Secretary at Perth a number of bones which had been brought in by a native from the site of the camp, and were believed to be the bones of John Baxter. The Colonial Secretary reported the find to the Governor, the Governor to the Secretary of State for the Colonies, and he to Mr. Eyre, then living in England, who wrote to the Governor expressing his melancholy satisfaction that the remains of his companion would now receive decent burial. But there is evidence that the remains were still in the Colonial Secretary's office in 1887, and no trace of their subsequent fate.

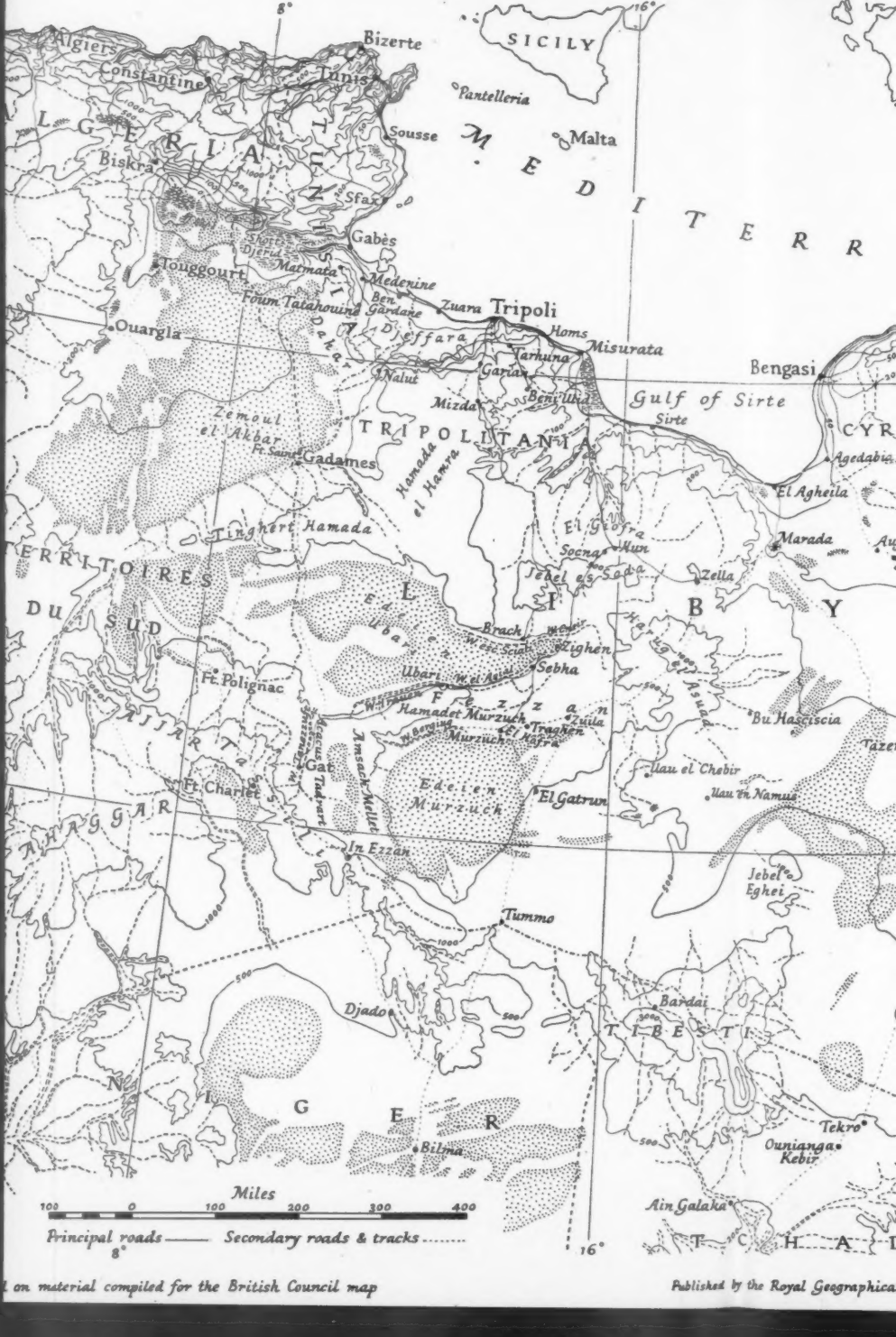
Mr. C. J. W. Aspland, of the Chief Secretary's Department, Perth, has sent to us the text of a paper which he read before the Western Australian Historical Society on 25 July 1941: "The mystery regarding the disposal of the remains of John Baxter . . ." from which the above facts are taken. After thirteen years' search in official records of all kinds he has found no clue to the mystery, and sends us the result of his inquiry for publication in whole or in part in the *Journal*. The paper will be preserved in the Library, to which the above abstract will direct the attention of any who may be interested.



Neozoic — Recent accumulations, alluvium, sand dunes, coastal dunes
Neozoic — Quartz pebble surfaces (serir)
Cainozoic — Oligocene and Miocene (sands, clays, limestones)
Cainozoic — Eocene (predominant limestones, some clays and sands)
Mesozoic — Cretaceous (upper limestones and lower limestones, sands and marls)
Mesozoic — Jurassic (marine limestone, continental limestone of Murzuch
Mesozoic — Trias (limestones and marls, marine)
"Nubian" — Continental sandstones, Palaeozoic to Mesozoic
Palaeozoic — Middle Carboniferous to ? Cambrian (marine beds, for the greater part, sandstones)
Archaean — Pre-Cambrian, crystalline schists, gneisses and intrusive rocks
effusive / intrusive — Volcanic rocks (for the greater part of Tertiary to Recent age)

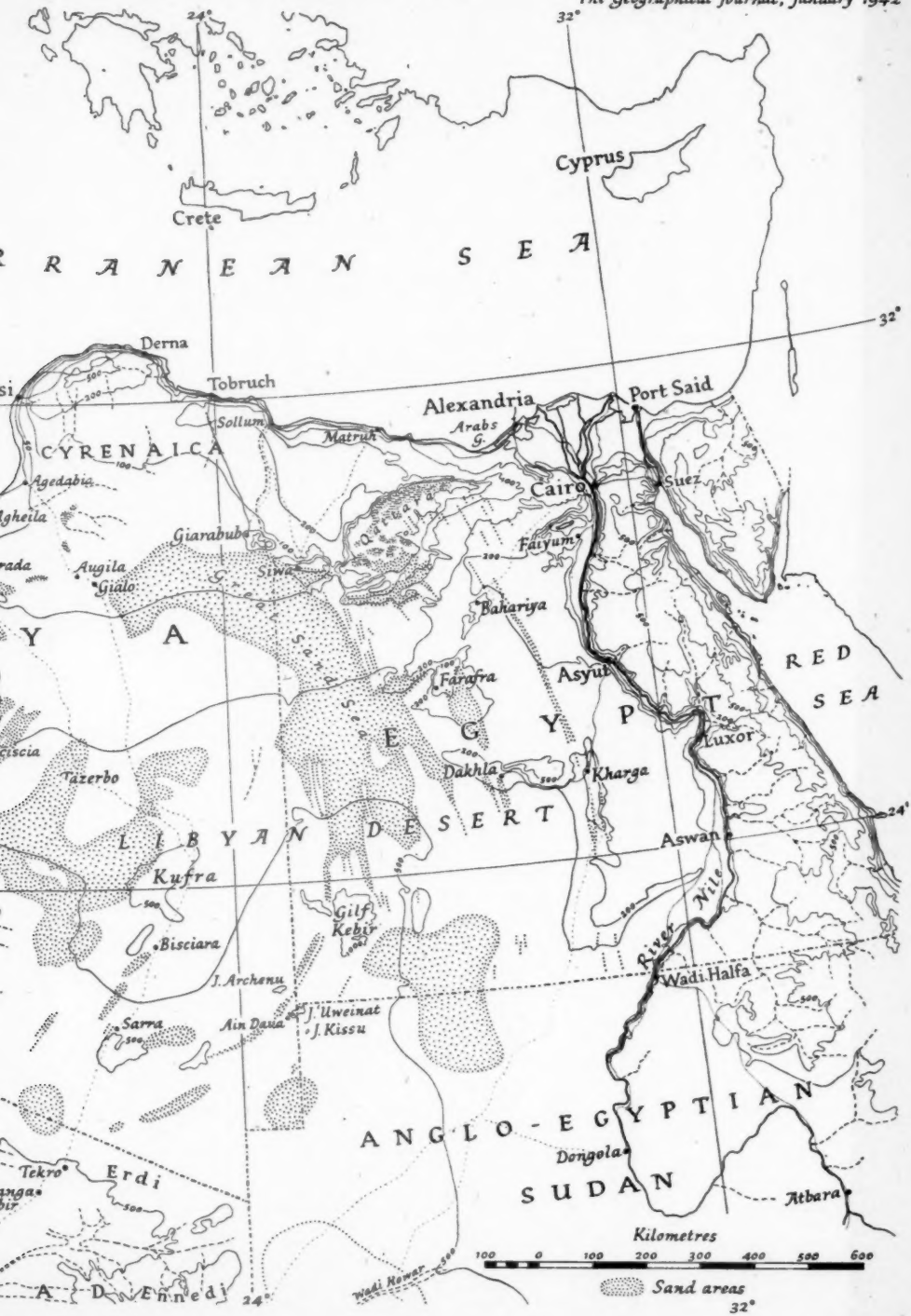
Based on m

THE WESTERN FRONTIERS OF L



on material compiled for the British Council map

Published by the Royal Geographica


Cyprus
Crete
R A N E A N S E A
Derna
Tobruch
Alexandria
Port Said
Sollum
Matruh
Arabs G.
CYRENAICA
Agedabia
Cairo
Suez
Giarabub
Augila
Siwa
Gialo
Fayum
Bahariya
Farafra
Asyut
RED SEA
Sand Sea
E G Y P T
Luxor
Dakhla
Kharga
Tazerbo
L I B Y A N D E S E R T
Aswan
Kufra
Gilf Kebir
River Nile
Bisciara
J. Archenu
Wadi Halfa
Sarra
Ain Dalia
J. Uweinat
J. Kissu
ANGLO-EGYPTIAN
Dongola
SUDAN
Tekro
Erdi
Atbara
Kilometres
100 0 100 200 300 400 500 600
Sand areas
A D Ennedi
Wadi Howar
24°
32°